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OF

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1912.

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MANUAL OF ELEMENTARY MILITARY HYGIENE.

CHAPTER I.

SANITATION IN THE ARMY.

1. *General Remarks.*

1. According to its derivation from the Latin and the use of the corresponding words in modern French and German, "sanitation," the synonym of hygiene, means health or health preservation, that is, the prevention of disease. In English there is a tendency to use the word as if it were synonymous with scavenging, conservancy, and the removal of refuse and filth generally.

2. Cleanliness in its broadest sense, whether of the individual, the house, the barrack, or the town, is no doubt closely associated with the preservation of health and the prevention of certain diseases, but sanitation or hygiene includes far more than this, for it is quite possible to have the most perfect cleanliness side by side with wide-spread disease. There are many diseases, some of them of particular importance to the soldier, which can be controlled and prevented but against which cleanliness alone would have little or no effect. Examples of these are malaria (or ague) and yellow fever, the poison or germs of which are conveyed from person to person by certain mosquitoes; Mediterranean fever, which results from drinking the milk of goats which have the germs of the disease in their bodies; plague, which is primarily a disease of rats and is generally carried to man by the bites of infected fleas which have come from plague-stricken rats; and small-pox, which spreads from man to man but can be prevented by vaccination. All of these diseases can be warded off by preventing the disease-germs spreading from person to person, but not by cleanliness as ordinarily understood.

3. It is necessary, therefore, to take a wider view of the subject and to study the causes of preventable diseases, and the appropriate means for warding them off, and for keeping men fit. It will be found that this includes far more than cleanliness as ordinarily understood.

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4. A few examples taken from [illegible] will best explain how the incidence of disease has been affected in consequence of the greater attention paid to the laws of health. Small-pox was once so common in Europe that few adults were to be seen who did not bear its disfiguring marks. Now, as the result of almost universal vaccination, the disease is [illegible] and similar vaccinations are being used with excellent results against other diseases, for example enteric fever and typhus. In former times, [illegible] of epidemic disease [illegible] of the population [illegible] of the civilized countries of Europe. Plague [illegible] Europe now it is so rare that many people [illegible] it. [illegible] Russia and Egypt, and [illegible] the last [illegible] [illegible] [illegible]

improvement, the numbers of sick in modern wars have reached enormous figures, and, except in very short campaigns, the deaths from disease have almost always far exceeded those from wounds. It is a fact not always recognized that the risks which are run on service are almost invariably far greater from disease than from the enemy's bullets.

In thirty-one months of the South African War, we lost in deaths from wounds 6,965 non-commissioned officers and men, and 13,590 from disease, while 72,551 were invalided back to England. For every man admitted to hospital on account of wounds, seventeen were admitted for disease.

In Appendices I and II a comparison is made of the effects of disease and wounds in some recent campaigns; from them it will be seen that, in the majority, far greater inefficiency and loss has been occasioned by disease than by wounds. This wastage is mainly due to a few diseases, all belonging to the class of infectious or preventable diseases, the propagation of which is peculiarly favoured by the conditions of camp life, the most important being enteric fever, dysentery, and, in certain parts of the world, malaria.

7. In civil life, and in barracks at home stations, arrangements for sanitation are provided by municipal agencies and governed by legislation, so that soldiers have little reason to consider them. In most barracks filtered water is laid on by pipes and ready to hand; water-closets, sinks, drains, and sewers are provided for carrying away waste matters; food supplies are supervised and food-stuffs inspected to prevent the conveyance of infection by them; ample space and ventilation are provided; hospitals for isolating those suffering from infectious diseases, and means for disinfecting their effects and discharges, are available.

On active service, on the other hand, large numbers of men are brought together without any of the elaborate arrangements for warding off disease that have protected them in peace, and the military administration and organization are required to deal with matters of which they have had little or no experience.

8. This brief summary should suffice to show that the efficiency of an army in peace and war is very appreciably influenced by its health, and that the improvements which have been effected in peace justify due attention being given to the subject, so as still further to reduce disease during peace, and, by bringing about some similar reduction on active service, to enhance the fighting efficiency of the military forces of the Empire.

2. *General Principles of Army Sanitary Organization.*

1. **"The study of sanitation and the preservation of health is incumbent on every officer and soldier."** The importance of sanitary measures, whereby health is preserved, cannot be over-estimated." (F.S. Regs., Part II, Sec. 70.)

Successful prevention of disease demands the co-operation of every individual, whether officer or man, and forms an essential

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4. A few examples taken from civil and military life will best explain how the incidence of disease has been reduced in consequence of the greater attention paid to the laws of health. Smallpox was once so common in Europe that few adults were to be seen who did not bear its disfiguring marks. Now, as the result of almost universal vaccination, the disease is comparatively rare, and similar vaccinations are being used with excellent results against other diseases, for example enteric fever and plague. In former times, typhus fever—an entirely different disease from enteric or typhoid fever—frequently appeared in huge epidemics* which killed thousands, now it is so rare that many have never heard of it. Enteric fever in England now accounts for less than one-fifth and tuberculosis only one-half of the deaths caused by these diseases forty years ago.

Statistics for the army show that there has been a great reduction in the sickness and mortality in times of peace in almost all our garrisons. In the last fifty years the military death-rate in the United Kingdom has been reduced by two-thirds. and the number of men constantly inefficient from sickness by more than one-half, while most other places show a similar, and some a still greater fall. The death-rate of soldiers is now considerably less than that of men of similar age in civil life, though this was not always the case.

In India, the death-rate of British soldiers is now one-fifth of what it was fifty years ago, and only one-half of what it was ten years ago; while the numbers constantly ineffective from sickness are less than three-fourths, and the number of invalids sent home less than one-third of what they were ten years ago. In other words, some 500 fewer soldiers die and 1,200 less are sent home as invalids every year, while the average numbers in hospitals are 2,000 less than was the case ten years ago.

In almost all foreign armies there has been a similar improvement in health.

5. Taking the whole army in all parts of the world, the diseases which cause the greatest mortality are enteric fever, abscess of the liver, pneumonia, tubercle of the lungs (consumption), and affections of the heart and circulation. The diseases which cause most inefficiency from sickness, though seldom fatal, are venereal diseases, malaria, and minor septic diseases, such as boils, abscesses, and similar affections. The main causes of invaliding are diseases of the heart, tuberculosis, and nervous and mental disorders.

6. On active service, a reduction in the number of men rendered inefficient by disease is even more important than in peace; for a sick man is not only a rifle lost to the firing line, but an actual encumbrance, requiring special food, housing, and transport; and the impedimenta that these entail do much to hamper an army. In the past it has been necessary to provide hospital accommodation for ten per cent of a force. Though there has lately been some

* An *epidemic* disease is one which is widely diffused and rapidly spreading attacking many people in any given area at the same time.

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improvement, the numbers of sick in modern wars have reached enormous figures, and, except in very short campaigns, the deaths from disease have almost always far exceeded those from wounds. It is a fact not always recognized that the risks which are run on service are almost invariably far greater from disease than from the enemy's bullets.

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8. This brief summary should suffice to show that the efficiency of an army in peace and war is very appreciably influenced by its health, and that the improvements which have been effected in peace justify due attention being given to the subject, so as still further to reduce disease during peace, and, by bringing about some similar reduction on active service, to enhance the fighting efficiency of the military forces of the Empire.

2. *General Principles of Army Sanitary Organization.*

1. **"The study of sanitation and the preservation of health is incumbent on every officer and soldier."** The importance of sanitary measures, whereby health is preserved, cannot be over-estimated." (F.S. Regs., Part II, Sec. 70.)

Successful prevention of disease demands the co-operation of every individual, whether officer or man, and forms an essential

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part of every scheme designed with that object. This fact has not always been realized, an idea prevailing that it is a matter for the medical service and for it alone. Such a view is absolutely wrong and cannot be too strongly combated.

No doubt much of the work of disease prevention is of a technical nature, which must be left to experts; but unless all officers and men realize that a low percentage of sick is a sign of efficiency and appreciate the reasons for the various measures, it is unlikely that they will be carried out with that thoroughness without which but little benefit can result.

2. The sanitary organization of the army is based on the principle that "the commander of every unit and formation is responsible for the sanitary condition of the quarters or localities occupied by his command, and for taking all measures necessary for the preservation of the health of those under him. He is also responsible for seeing that each officer and soldier observes all sanitary orders, and for the good order and cleanliness of that portion of a quarter or locality under his charge, irrespective of the period for which the latter may be occupied." (F.S. Regs., Part II, Sec. 70.)

3. The present scheme of sanitary organization is designed to provide every unit with trained sanitary personnel, not for the purpose of relieving men of their responsibilities, but with a view to directing their efforts on correct lines.

Details of the number of officers and men allotted to the forces in the field for the special purpose of efficient sanitary organization are contained in War Establishments, and the sanitary organization and duties of an army in war are laid down in Field Service Regulations, Part I, Chap. IV and Part II, Chapter X.*

* See also R.A.M.C. Training.

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CHAPTER II.

THE CAUSES OF DISEASE.

3. *Classification of Diseases.*

1. It is not easy in a few words to give a definition which will include all diseases, but they may be divided up roughly into three main classes:—(*a*) Those due to a disturbance of the functions of the body caused by some physical condition such as defective food, heat, cold, etc., or by some unknown agency; such diseases are dyspepsia, scurvy, heat-stroke, frost-bite, cancer, etc. (*b*) Those resulting from the body being attacked by minute, parasitic, living organisms or germs which are capable of being transmitted from a person who is suffering from one of the diseases to other people. This class of disease is known as infectious or communicable disease. (*c*) Those caused by vegetable and animal parasites of larger size and higher in the scale of the vegetable and animal kingdoms; such are various fungi which cause skin-diseases, and different species of worms which may inhabit the intestines and other parts.

2. Hygiene is chiefly concerned with the class of infectious diseases and those caused by the larger parasites.

4. *Germs.*

1. Those germs which belong to the vegetable kingdom are called bacteria; enteric fever, cholera, diphtheria, Mediterranean fever, and plague are all caused by such organisms. Other germs called protozoa belong to the animal kingdom; the germs of malaria and of sleeping sickness are of this kind.

Each disease is caused by a distinct species of germ which causes that one disease alone; the germ of cholera causes cholera only, and not enteric fever or malaria, and so on. In some diseases, for instance, smallpox, measles, and rabies (or hydrophobia), no germ has yet been found.

2. Bacteria are extremely minute cells of various shapes. They may be spherical or oval, when they are called micrococci; elongated like short rods, when they are called bacilli; or curved, when they are called vibrios. The germs of pneumonia and Mediterranean fever are micrococci, those of enteric fever and diphtheria bacilli, and that of cholera a vibrio.

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Like all plants and animals, bacteria require food, and in order to flourish must live in a suitable temperature and have a sufficient amount of moisture.

3. Bacteria can reproduce their kind by simply dividing into two, and in favourable circumstances they multiply in this way, at an enormous rate; at the end of twenty-four hours seventeen millions may be produced from one individual. Certain species, in addition to this method of reproduction, form spores, *i.e.*, seeds, one or sometimes two of which appear in the body of the germ; when placed in suitable surroundings these spores develop into complete bacteria. Bacteria containing spores are much more resistant to heat, drying, and chemical substances than those without spores. The bacillus of tetanus or lockjaw is one of those that form spores.

Bacteria always breed true; the plague bacillus, for example, always reproduces a plague bacillus and not the germ of any other disease.

4. There are an immense number of different kinds of bacteria. The vast majority are harmless, and many are absolutely necessary for the processes of nature. For instance, it is by the aid of bacteria that the nutriment contained in the soil and in manures is decomposed or broken up into substances that can be taken up by the roots of plants for food. Again, were it not for bacteria, butter would have none of the flavour that we associate with it, for the ripening of the cream from which it is made is due to their action. So, also, it is necessary for the digestion of our food that certain kinds of bacteria should be present in our alimentary tract.

5. Disease-germs reach the body by various channels, of which the following are the principal:—

i. They may be contained in food or water and be swallowed, and so reach the alimentary tract. They can get into food and water in various ways:—(*a*) The animals from which the food is derived may be suffering from the disease. Milk from tuberculous cows will cause tuberculosis in human beings; and milk from goats affected with Mediterranean fever is the most common, if not the only, source of that disease. (*b*) They may get into food by infected persons handling it. To infect food in this way an individual need not be suffering from the disease in a recognizable degree; he may be in the very early and unrecognizable stage, or he may have so slight an attack that it is unnoticed, or he may have recovered from the disease but still contain the germs of it in his body, or, having been in very close contact with persons suffering from the disease, he may harbour the germs in his system, although himself not susceptible to the infection. Diseases spread in this way are enteric fever, scarlet fever, and diphtheria. (*c*) They may be carried to food from infected human excreta by flies and dust; this happens with enteric fever and dysentery. (*d*) They may get into water from the excreta of man, through sewage contamination soaking or being washed into it; enteric fever and cholera are spread in this way.

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ii. They may remain for a certain time suspended in the air (attached to particles of dust), when coughed up by those suffering from infectious diseases of the lungs or air-passages, or, possibly, when shed from the skin in certain diseases. In this way they are inhaled and reach the throat or lungs of others; this happens in diseases in which the infectious matter is on the skin as in small-pox and, possibly, in scarlet fever, and in those in which it is coughed up as in tuberculosis of the lungs, diphtheria, and pneumonia.

iii. They may pass from man to man by personal contact. For instance, attendants may get their hands or clothes soiled by infected discharges from the sick, whence the infecting matter can easily get to their mouths; similarly infection may be spread among men living close together as in camps or barracks. Enteric fever is spread in this way; gonorrhœal inflammation of the eyes may be caught by a man using the towel of another who has the disease, and syphilis by smoking the pipe of a syphilitic man.

iv. They may get directly into the blood through an accidental cut or abrasion of the skin, as in tetanus and blood-poisoning; or by puncture of the skin by biting insects, as in malaria and yellow fever where certain mosquitoes are the carriers of the germs, and in sleeping sickness for which a biting fly is the agent.

6. In whatever way the disease-germs enter the body, and in whatever part of the body they take up their abode, in almost all cases, though they multiply they produce no symptoms for a certain time, the period varying in different diseases. The interval between the entrance of the germs and the appearance of symptoms is called the "incubation period"; it may be as short as two or three days, as in cholera, or as long as three or four weeks, as in some cases of enteric fever.

During this period the germs produce a poison or *toxin*, and it is the circulation of this toxin which makes a man ill and gives rise to the various symptoms of the disease.

5. *Immunity from Disease.*

1. It is well known that if a number of persons are equally exposed to the infection of a certain disease all will not catch it, and of those who do catch it some will suffer more severely than others. For instance, out of a battalion 500 or 600 strong, 135 men were attacked with cholera, yet it was found that for several days all had been drinking water contaminated with the germs. Again, out of a detachment of 3 officers and 93 non-commissioned officers and men who all drank water contaminated with enteric fever germs, only 1 officer and 30 non-commissioned officers and men were attacked. The freedom of those who escape is due to what is known as *immunity;* and this immunity rests upon the facts that not only is it necessary to have the particular germ which causes the disease, but also a suitable soil for it to grow in and multiply and produce its poison. This is not always the case in our bodies.

2. This power of resisting disease, or "natural immunity," is possessed by all, but its degree varies in different individuals, and

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in the same individual it varies with different diseases and at different times. It is well known, for instance, that immunity to enteric fever rapidly increases after the age of about thirty; that is to say, from that age onwards people are less liable to catch the disease when exposed to the infection.

The degree of immunity also varies, apparently, in some not very well understood way, with the general health of the individual at the time he is exposed to infection. Alcoholic excess seems undoubtedly to make a man more liable to pneumonia and consumption; similarly, cold, exhaustion, a vitiated atmosphere, and insufficient or unsuitable food are believed to lessen immunity to a number of diseases.

A person may carry the germs of pneumonia, rheumatism, influenza, malaria, or dysentery in his body without their causing any symptoms, but cold and wet, a chill as it is called, may lessen his natural immunity and enable the germs to flourish and set up the disease.

3. Immunity may also be "acquired." An attack of most of the infectious diseases confers partial, in some cases almost complete, immunity for a longer or shorter period against further attacks of the same disease. "Acquired immunity" is also conferred by vaccinations such as those for smallpox, enteric fever, and plague.

4. Immunity, whether natural or acquired, is due to certain substances in the blood which have the power of killing the germs which get into it, and of neutralising their poisons. A certain quantity of these substances always exists in the blood: and whether it is in sufficient amount, and of the right kind to deal with the invading germs or not, decides the question as to whether the individual will suffer from the disease or will resist infection.

5. The likelihood of contracting a disease increases with the quantity of germs which enter the body; for the blood may be able to deal with a small number, but if many are introduced the substances in the blood may not be enough to deal with all.

6. *Bacillus-carriers.*

1. It is possible for the bacteria of certain diseases to exist and multiply in the body without the individual suffering any ill-health at the time; but he may be passing out large numbers of disease-germs in his urine, etc., and actually spreading the disease. People who thus harbour and excrete disease-causing bacteria are called "carriers" or "bacillus-carriers." This condition is generally met with in persons who have recovered from, or who have been in close contact with persons suffering from an infectious disease, of which enteric fever is the best known and conspicuous example.

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CHAPTER III.

The Chief Diseases of Soldiers.

Having considered generally the causes of disease, the next step is to give a brief outline of the more important diseases to which the soldier is liable,* so that the policy adopted for their prevention may be intelligible.

7. *Cholera.*

1. This disease used to be very common among British troops in India. It is endemic† there among the civilian native population in certain parts, and epidemics are common where large numbers of natives, especially pilgrims, are collected together; it frequently spreads to Europe. The disease usually comes on suddenly, but may commence with slight diarrhœa. The patient suffers from severe cramps, the face is pinched, and the whole body becomes cold. There is violent purging and vomiting of material resembling water in which rice has been boiled. Death frequently occurs in a few hours. The bowel discharges and vomit of sick persons contain the germs in enormous numbers. There is also some evidence that, as in enteric fever, convalescents and apparently-healthy people may excrete the germs for long periods.

2. The disease is caused by a special germ, shaped like a printer's comma, which is taken into the body by the mouth, usually in water, but also in milk or other food infected with the germ.

The most common channel of infection is water, but articles of bedding and clothing soiled by the sick have also given rise to the disease. The germ may also pass into the food through the agency of native servants. Men who suffer from indigestion, or worry about the disease, are liable to contract cholera in epidemic times. This is probably due to some interference with the secretion of the gastric juice, which in health has the power of destroying cholera germs taken into the stomach.

3. The essential preventive measures are the safeguarding of water and food from contamination, care in the disposal of excreta, rigid personal cleanliness, early detection and isolation of the sick. In cholera epidemics care should be taken to avoid indigestible foods, excess of alcohol, uncooked vegetables, unripe fruit, and anything likely to upset the stomach. Owing to improved methods of sanita-

* These are arranged alphabetically in this chapter.

† An *endemic* disease is one pertaining to or prevalent in a particular district or region.

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tion and the provision of pure water supplies, cholera has now practically disappeared from amongst British troops in India under peace conditions. Serious outbreaks may, however, occur on active service, and, owing to its very high mortality, cholera is one of the most important infectious diseases.

8. *Dysentery.*

1. This disease has frequently been prevalent during war. In the South African campaign there were 38,108 cases and 1,342 deaths. The disease commences suddenly, the symptoms being pain in the bowels, a constant desire to go to stool, severe straining, and the passing of slime and blood. It is, in fact, an inflammation and ulceration of the large intestine.

2. Dysentery is caused by germs which enter and leave the body by the same channels as those to be described under enteric fever. Chills and exposure to damp and wet have a powerful predisposing influence. Blankets and clothing used by the infected are very liable to convey the germs to others who may use them; flies also are frequent carriers of infection.

3. The preventive measures of dysentery are much the same as in the case of enteric fever, viz., care in the disposal of excreta, protection of food and water from contamination, personal cleanliness, and early detection of cases of the disease.

9. *Enteric Fever.*

1. This disease, often called typhoid fever, is common all over the world, and has been a constant scourge of armies during war. In the South African War nearly half the deaths from all causes were due to enteric fever.

2. Enteric fever is caused by a germ which enters the human body in a variety of ways, notably by water, milk, or food, such as oysters and shell-fish, and by dust-laden air. The disease comes on gradually in from eight to twenty-one days after the germ has gained access to the body. It is characterised by continued fever, great weakness, and usually by diarrhœa. The bowels are frequently ulcerated, and the infected person gives off large numbers of the infectious germs in the urine and fæces, not only during the whole course of the disease, but also in many cases for some weeks after convalescence and recovery. About three per cent. of the cases continue to excrete the germs for years after recovery from the disease, and while apparently in perfect health. These persons are called "*carriers*," and many outbreaks of enteric fever, both among soldiers and civilians, have been traced to them.* Another characteristic of enteric fever is that many mild cases occur, so mild indeed that the persons attacked do not report sick. Cases of this kind are common among soldiers and are potent factors for evil, as the individuals are distributing enteric germs broadcast and undetected.

* See Chapter II, Sec. 6.

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3. Severe epidemics of enteric fever are nearly always caused by water which has been fouled by sewage containing enteric germs. Smaller outbreaks and those developing slowly are more commonly due to infected food. This infection may arise through the agency of flies, which pass from garbage or other filth to food, and also by means of dust containing enteric germs blown on to food. Cooks and waiters in messes who are unsuspected "carriers" may also infect food. Oysters and shell-fish taken from beds where the water is polluted with sewage, and vegetables, such as lettuce and water-cress, washed or watered with water contaminated by excreta, may also give rise to enteric fever. Another way in which the disease may arise is the use of blankets, bedding, or clothing infected by "carriers" or by mild undetected cases who have never reported sick.

4. This summary of the channels of infection suggests certain precautions. No food or drink whose history is unknown should be taken without being sufficiently heated to destroy any enteric germs. Food which is stored before issue should be adequately protected from flies and dust. Milk in particular should be specially safeguarded, as it forms a favourable medium for the growth of germs. The safe disposal of excreta is of particular importance. Latrines and urinals should be kept sweet and clean, and where the dry-earth system is in vogue especial care should be taken to see that the excreta are properly covered with earth to prevent the access of flies. In many stations abroad dry earth has been abandoned, and disinfectants which act as fly deterrents are placed in the pans. With a similar object in view, seats are washed and floors sprinkled with disinfectants. The personal cleanliness of the soldier must be carefully supervised; this involves not only the cleanliness of the man, but also of his clothing and bedding. Lastly, the experience of recent years has shown that inoculation is a powerful aid in resisting the attacks of enteric fever; especially is this true of the young soldier proceeding on foreign service.*

10. *Heat-Stroke.*

1. Heat-stroke, in its severe form, is a well-defined and easily recognized condition. It should not be confounded with heat-exhaustion, which is merely a form of fainting from which men are apt to suffer when marching in a hot climate. Sunstroke is the term usually applied to heat-stroke due to exposure to a hot sun.

* See also Chapter IV, Sec. 19. What can be effected by sanitary precautions and inoculation against enteric fever is well shown in the following table, which gives some recent figures for that disease among British troops in India:—

	Ratios per 1,000.	
	Admissions.	Deaths.
1894-1903	22·4	5·83
1904	19·7	3·76
1905	16·1	3·00
1906	15·6	3·19
1907	13·1	2·77
1908	14·6	2·79
1909	8·9	1·58
1910	4·1	·62
1911	2·3	·30

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2. Heat-stroke consists of a great rise in the body-temperature*, to 106°, 107°, or even 109°, coming on during very high atmospheric temperature, whether the heat is natural or artificial. The attack may come on gradually, with fever and its usual accompaniments of headache, drowsiness, etc., for which the man lies down, and later is found unconscious with snoring respiration, a temperature of 107° or over, and a very dry skin. On the other hand, it may come on suddenly, more especially on the march, and the man attacked will fall down without warning in an almost unconscious state.

Exhaustion no doubt predisposes to an attack, and it is quite certain that a very large proportion of those who suffer have been taking alcohol to excess, in most cases habitually.

In India, the places with the highest mean temperature during the hottest months are those which show the greatest number of cases.

3. The principal measures of prevention consist in avoiding the least excess in alcohol and in eating, especially in eating meat. Clothes should be as light and loose as possible, and in the tropics the head must be protected by a wide-brimmed, ventilated hat shielding the eyes, temples, and neck. The hat should be worn continuously while exposed to the sun. During marches in hot weather the weights carried should be reduced to a minimum, the most open order practicable should be allowed, and halts should be frequent; coats and shirts should be worn open.

4. Treatment consists in placing the individual in the shade, removing all clothes, and douching the whole body with the coldest water available.

11. *Malaria.*

1. The various types of malaria, commonly called ague or "fever," cause much inefficiency among soldiers in many of our foreign garrisons. Malarial fevers are severe in West Africa, South China, India, Mauritius, and the Straits Settlements. These fevers are usually characterised by three successive stages, (*a*) the cold stage when the patient shivers and feels cold; (*b*) the hot stage when the patient has a flushed face and feels hot; and (*c*) the sweating stage when there is profuse perspiration and the fever disappears. In severe forms of malaria these stages are not differentiated and the patient suffers from continuous fever.

2. Malarial fevers are caused by a small germ, varying in each type of fever, which develops in the red corpuscles of the blood. Each germ gives rise to younger forms which escape from the infected corpuscle into the blood-stream and then attack other healthy corpuscles. Each attack of fever corresponds with this liberation of young forms and the infection of healthy blood-cells, and occurs every 24, 48, or 72 hours, according to the time which the type of germ takes to complete its existence in the blood-corpuscle.

* The normal temperature of the body is 98·4°F.

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3. Some of the germs may not give rise to young forms, but grow into large parasites of varying shape. Should the man be bitten by a certain kind of mosquito, these bodies are sucked in with the blood on which it feeds, and after developing in the insect's interior for eight to ten days eventually reach the salivary glands. If the mosquito now bites another man, the germs are injected into his blood, and entering the blood-corpuscles develop again as just described.

4. The various mosquitoes which convey the germ of malaria from man to man belong to one family, known as the *Anophelina*. Many of these have spotted wings, and when at rest appear to form an angle with the surface. Each mosquito passes through four stages—the egg, the larva, the nymph, and the perfect insect. The eggs are laid on the surface of water, and after a few days hatch out into larvæ, which usually lie almost horizontally beneath the surface. In about twelve days the larva is fully grown and becomes a nymph, which is not unlike a very small tadpole. After three or four days the perfect insect hatches out and flies away.

5. From what has been written it will be evident that for the prevalence of malaria there must be a previous case of malaria, anopheline mosquitoes, and favourable climatic conditions. In the absence of these factors an outbreak of the disease is impossible.

6. The preventive measures based on these facts may be classified as follows:—

i. *The removal or isolation of infected people.*—All patients suffering from malaria should be isolated from other people, and placed in mosquito-proof wards or protected by curtains. Natives of tropical countries, and especially the children, often have germs of malaria in their blood, and should be kept as far away from troops as possible. Native huts should be at least half a mile from camps or cantonments.

ii. *The destruction of the germs in the blood of infected people.*—Quinine kills the germs in the early stages of their development, and is used extensively in the treatment of actual malarial cases. It is also employed to prevent the growth of the germs, should they be injected by a mosquito. This so-called prophylactic measure aims at maintaining in the blood a sufficient quantity of quinine to kill the parasites. The drug is given in doses of 10 to 15 grains on two successive days twice a week, or in 5-grain doses daily.

iii. *Protection of healthy people from mosquito bites.*—This may be done by protecting all the doors, windows, etc., of a house with wire-netting, or by providing each bed with a mosquito-curtain.

iv. *Destruction of mosquitoes and removal of their breeding places.*—This is the most important administrative measure, and has been successfully employed in many places, notably at Panama and Ismailia. During the daytime, adult mosquitoes seek protection in vegetation, and enter neighbouring habitations in the evening. Vegetation near houses and barracks should therefore be removed as much as possible. Mosquitoes can be stupefied by burning sulphur or pyrethrum in the rooms, their bodies being subsequently

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swept up and burned. This measure, however, is not very effective and efforts should mainly be directed towards removing the breeding-places of mosquitoes. They usually breed in shallow, stagnant water; hence collections of water in gutters, tubs, and other vessels in the vicinity of houses and barracks should not be permitted. Large pools, ponds, and marshes near barracks should be drained. If this is impossible, much benefit results from pouring kerosene oil on to them in the proportion of one pint to each 400 square feet. If drinking-water for troops in barracks has to be stored in tanks these should be covered with wire-netting to prevent the access of mosquitoes. All hollows near barracks should be filled in to prevent the lodgement of rain-water, in which mosquitoes readily breed. Anopheline mosquitoes breed, for preference, in the quiet water at the edges of streams where vegetation overhangs the banks; it is important that these should be kept clear.

12. *Mediterranean Fever.*

1. This disease, formerly called Malta fever, prevails in Gibraltar, Crete, Algiers, and Tunis, as well as in Malta. Cases of the disease have also occurred in India, China, and South Africa. Up to the year 1906, Mediterranean fever had a marked incidence among the troops in Malta and caused considerable loss to the State. For this reason Malta was regarded as one of the most unhealthy of foreign stations.

2. Mediterranean fever is characterized by successive attacks of fever, each attack lasting for three weeks to a month. Relapses are common, so that the disease frequently extends over many months or even years. There is pain in the joints resembling rheumatism, and so much debility follows the illness that the services of the soldiers affected are lost for long periods.

3. The disease is caused by a small germ which is found in the milk of infected goats. The goats themselves often do not show any signs of illness and the milk appears quite unchanged. After the discovery that the germ existed in goat's milk, soldiers were forbidden to drink it, and the disease has now practically disappeared from the troops, though it still prevails amongst the Maltese, who persist in drinking such milk.

13. *Plague.*

1. Plague has never been prevalent amongst the troops, though it has prevailed to a deplorable extent amongst the native population of India. The illness is characterized by high fever and painful swellings of the glands, generally in the groin or arm-pit. A very fatal form is marked by severe inflammation of the lungs without swelling of the glands.

2. The disease is caused by a special germ which is conveyed to man chiefly through the agency of fleas which have fed on plague-stricken rats. In India the black rat is found in the houses of the people, who usually go about with bare feet and legs, and this accounts for the

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prevalence of plague amongst the natives. In England the brown rat has taken the place of the black rat, and as it chiefly lives in the fields there is not the same danger to the occupants of houses and barracks as exists in the tropics, should the rat population become infected. The majority of the cases which have occurred amongst white troops have been in men who have either volunteered for plague duty or have associated with natives in bazaars.

3. These facts indicate that to prevent the occurrence of plague among soldiers native houses and quarters must be avoided and rats and fleas exterminated. Buildings and barracks must be maintained in good repair, special care being taken wth the floors. Native servants and others visiting military lines must be carefully supervised.

14. *Scurvy.*

1. This disease is liable to occur in besieged garrisons and on board ship in circumstances when fresh food cannot be obtained. In Port Arthur, at the time of surrender, there were 9,093 cases out of a total of 11,105 sick. The disease is not contagious or infectious, and does not depend on a particular germ. The cause seems to be the absence, or deficiency, of certain necessary constituents which are present in fresh meat, fruit, and vegetables. The early symptoms are pains in the calves of the legs, and general weakness through the impoverished state of the blood; later, the gums become swollen and marks like bruises appear on the body.

2. Scurvy may be prevented by the issue of fresh meat, vegetables, and fruit. When these cannot be obtained a daily issue of one ounce of lime-juice should be made.

15. *Tuberculosis.*

1. At one time tuberculosis of the lungs, or consumption, was the cause of much invaliding in the army. It is an infectious disease caused by a germ which attacks various parts of the body, but more commonly the lungs in adults and the bowels and coverings of the brain in children. The infection is slow, causing the disease to run a protracted course, and usually terminating in death when the lungs are the seat of the disease.

2. The chief channels of infection are the air and milk. When the disease is in the lungs, the act of coughing ejects the germs in the form of a spray; they are also present in the sputum, which when dried is carried about by currents of air. The breathing-in of germs which have been set free in these ways is the most common source of infection among adults. Milch cows suffer extensively from tubercle, and as the germs are excreted in the milk this food is a fruitful source of infection among children. In the case of the soldier, however, infected milk probably plays no part. The flesh of infected animals may also contain the germs, but the danger from this source is probably not great, as cooking may be relied upon to destroy the bacteria.

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3. At the present day tuberculosis occurs much less frequently among soldiers than among civilians of corresponding ages. The reduced incidence of the disease is attributable partly to the great attention now paid to good ventilation in barracks and the provision of sufficient cubic and floor space for each man, and partly to the prompt isolation of cases of tuberculosis of the lungs. This policy reduces to a minimum the opportunity afforded for the spread of tubercular infection among soldiers. It is important that regimental officers should realise the methods of infection, and co-operate by preventing over-crowding in barrack-rooms and by enjoining on their men the necessity of maintaining cleanly habits.

16. *Venereal Diseases.*

1. These diseases cause more inefficiency from sickness than almost any other form of preventable disease. Under this general heading there are included three distinct affections, namely, syphilis, gonorrhœa, and soft chancre.

i. *Syphilis* is a constitutional disease caused by the entrance into the body of a special germ, which usually gains access to the tissues through some small abrasion. The disease is characterized by three stages, namely, a first stage marked by the presence of a sore or ulcer, usually on some external part; then follows the constitutional infection marked by the appearance of a rash on the skin. If treatment be applied vigorously at this stage no further signs of disease may occur; but if neglected a third stage supervenes in the course of some months, or a year or two, characterized by nervous troubles and the growth of swellings in various parts of the body. The seriousness of syphilis lies in the fact that not only is the soldier rendered inefficient for a long time, but also that, if he marries before he has been cured, his children are liable to be infected.

The usual source of infection is sexual intercourse, but as the germ may enter through any cut or abrasion the disease may be acquired in other ways, for example, by a soldier smoking the pipe of a diseased comrade.

ii. *Gonorrhœa,* though far more common than syphilis, is not so far-reaching in its effects. It is caused by a germ which sets up a violent inflammation in certain parts, and may also give rise to a troublesome and often serious form of rheumatism. Following on several attacks of gonorrhœa, a stricture or narrowing of the urinary passage may occur, which, if neglected, may cause disease of the bladder and kidneys. Gonorrhœa is usually acquired by sexual intercourse, but the infection may be conveyed to the eyes by using the towel of a man suffering from the disease.

iii. *Soft Chancre* is essentially a local disease and is characterized by an ulcer on the part affected. It is often accompanied by inflammation and abscess of the glands in the groin.

2. The only true safeguard against venereal disease is abstention from promiscuous intercourse with women; but, having regard to the method of transmission, thorough washing after connexion may lessen the chances of infection. It is important that the

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soldier should realize the gravity of venereal disease and the necessity for early and proper treatment.

17. *Yellow Fever.*

1. At one time this disease devastated many of our garrisons in the West Indies, Bermuda, and the West Coast of Africa, but in the present day it rarely occurs in the army. It used to be considered a "filth" disease, depending mainly on insanitary conditions, but it is now known to be caused by a germ carried from one person to another through the agency of a particular mosquito, which has white bands on the legs and abdomen and is known as the "Brindled Mosquito." This mosquito is found in abundance in Mexico, Central and Southern America, and the West Indies, as well as in many other places in tropical and sub-tropical countries.

It breeds in the clean-water cisterns in the yards of houses, in tanks, barrels, and other receptacles, and passes through the same stages of development as the mosquito which carries the germ of malaria.

2. The preventive measures are similar to those described under malaria, namely, destruction of mosquitoes and larvæ, protection of water receptacles from the access of mosquitoes, removal of breeding-places, prompt isolation of the sick in mosquito-proof rooms, and protection of houses by rendering doors, windows, and verandahs mosquito-proof. These measures have been so successful in Havana and elsewhere as practically to abolish the disease from places which previously had never been free from it.

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CHAPTER IV.

THE PRINCIPLES OF DISEASE PREVENTION.

18. *General Remarks.*

1. From what has been said about the causes of disease and the channels of infection, it follows that the prevention of disease must include:—(*a*) measures to maintain or increase the resisting powers of the individual; and (*b*) measures to prevent or lessen the possibilities of disease-germs entering the body. Among the former, a prominent place must be given to protective inoculation, while among the latter are included such matters as personal cleanliness, clean air, clean barrack-rooms, clean food, clean water, and clean and wholesome billets and camps.

19. *Protective Inoculation.*

1. Mention has been made of the fact that in the case of the majority of the communicable or infectious diseases an attack does not often occur a second time; notable examples in which this is the case are enteric fever and smallpox. This being so, the question suggested itself whether men could not be given or put in the way of acquiring a mild form of the disease, so that future infection of a severer nature might be rendered improbable, if not impossible.

2. Formerly, in the case of smallpox, people were inoculated with the disease itself in the hope of giving them a mild form of the infection and so preventing the occurrence of severe cases. Owing to faulty methods severe cases occurred, and the disease got so much out of hand that the practice of inoculation with smallpox had to be forbidden. Its place is now taken by the modern procedure of vaccination, which consists in inoculating or infecting human beings with vaccinia, a disease believed to be smallpox modified by passage through the cow or calf. The blisters which appear on the animal yield a juice or lymph, which, if inoculated (vaccination) into man, confers on him an ability to resist infection by the human smallpox.

3. A similar idea is present in the attempts to ward off infection by enteric fever by injecting the killed germs into man. This does not give him the disease, but causes him to manufacture an antidote (antitoxin) in his blood, which enables him to resist infection by natural means. Unfortunately, the protection thus

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provided lasts only some two years; but even so, it is worth having, especially if it tides a young soldier over a critical period, when his powers of resistance to the disease are likely to be low and the chances of infection great.

4. It may be asked, what is the evidence in favour of the practice so far as relates to enteric fever in the army? All reports indicate that the admission rates for enteric fever are much less among the inoculated as compared with the uninoculated, while the mortality rates from the disease are also favourable to the inoculated. In a recent series of three years, during which period the greatest care has been taken to secure accuracy of facts and figures, 2,969 men were inoculated in various units, while 3,897 men in the same units were not inoculated. These represent 6,866 men belonging to different corps and all exposed to the same chances of infection. Among the 2,969 inoculated there occurred 11 cases of enteric fever with 1 death, and among the uninoculated 128 cases with 17 deaths. This means that for each 1,000 of the inoculated men there were 3·7 cases of enteric fever, while for each 1,000 of the uninoculated there were 32·8 cases. These figures justify a belief that protective inoculation is a powerful aid in rendering the body more resistant to possible infection by the germs of enteric fever. Advantage of being so protected should be taken by every soldier, more especially when proceeding on foreign service.

5. At present, the power to ward off infection from diseases of an infectious nature by means of preventive inoculations is still limited to a few of them. Failing, then, a complete scheme of protection against all the infectious diseases by means of preventive inoculations, what other steps can be taken? The answer is a rational and wholesome mode of life, with clean air, clean food, clean water, and cleanly surroundings secured by a proper removal of filth and waste material, combined with organized control of the infected, and disinfection of their clothing, products, and surroundings. These subjects are dealt with in the subsequent chapters.

20. *Control of Infection.*

1. The occurrence of a case of infectious disease* calls for prompt measures to be taken (*a*) to find out how and why it has occurred, and (*b*) to prevent its extension to others These are technical problems for the medical service to deal with, and the greatest importance attaches to their correct solution.

2. The first step to be taken is that of isolation of the sufferer from others not similarly attacked. In the case of soldiers this means removal to the infectious disease hospital or such other place as may conveniently lend itself for the reception of an infectious disease. In the case of children or other persons resident in married quarters a similar procedure must be adopted, unless exceptional

* For example, cholera, diphtheria, enteric fever, erysipelas, measles, plague, scarlet fever, smallpox, typhus fever, and yellow fever.

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circumstances exist which either preclude the removal of the case with safety, or permit of adequate and complete isolation. This latter contingency will rarely be possible. Concurrent with these steps it may be necessary to segregate others, commonly termed "contacts," who may have been exposed to infection.

3. In cases of infectious or contagious diseases, special care must to taken to prevent children of the family affected, or those on whom suspicion may rest as having possibly been exposed to infection, from attending school until the period of incubation has elapsed. Schools should only be closed in times of exceptional prevalence of infectious disease. It is far better to keep the children of one or more families away from a school than to close it altogether.

4. The second step is the careful collection of all clothing, bedding, and other articles which have been in use by the infected person. These should be promptly despatched for disinfection by steam. "In cases of epidemic disease, every care will be taken to secure that articles likely to convey infection are not returned to the barrack expense or ordnance store. Should there be any reason to believe that infected articles of bedding, clothing, tentage, etc., have been so returned, the officer concerned will be at once warned." (King's Regulations.)

21. *Disinfection.*

1. Disinfection means the application of some process by means of which the disease-germs are destroyed. The mere removal of a smell or the delaying of the growth of bacteria is not disinfection. Disinfection is essentially a matter for the medical service, but every necessary facility must be afforded to it by the unit affected, as any failure to carry out the process thoroughly renders all other efforts to control infection valueless.

2. Rooms which have been occupied by infected persons can only be disinfected after they have been vacated. The object is to disinfect all exposed surfaces on which germs are liable to lodge. The disinfection of the air is effected sufficiently by opening windows and admitting fresh air and sunlight. Except in the case of places which have been occupied for some time by those suffering from smallpox, scarlet fever, or tuberculosis of the lungs, or where three or more cases of an infectious disease have occurred in one room, it is rarely necessary to disinfect a room simply because a case of infectious disease has occurred among its occupants. The reason for this is that the germs or causative agents of the majority of the infectious diseases attach themselves to the persons, bedding, clothing, and other personal articles of the infected, and not to walls, ceilings, fittings, or floors. In the majority of cases these latter can be rendered free from infection by means of thorough ventilation, admission of light, and scrubbing with soap and water.

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CHAPTER V.

WATER.

22. *General Remarks.*

1. Water is necessary for all animal and vegetable life. Constituting over sixty per cent. of the weight of the human body, it is being continuously excreted from the skin, kidneys, intestines, and lungs, and must be replaced. Besides this it is necessary for cooking, washing, and other domestic and industrial purposes.

2. The amount of water allowed in barracks at home is 20 gallons for each adult, 10 for each child, and 20 for each horse. In India, each European is allowed 20 gallons in the plains, or 15 in the hills; each native 15 or 8, and each animal 10 gallons.

3. In camps and bivouacs these amounts are seldom available, and would not be desirable on account of the difficulty in getting rid of the polluted water without an elaborate system of drainage. In standing camps 5 gallons per head and 10 for each horse are considered sufficient. In estimating the minimum quantity required, it must be remembered that a man, to make up the loss of fluid from the body, requires from 3½ to 5 pints daily, of which about one-third is contained in solid food; half a gallon will therefore be required for drinking and the same amount for cooking, or 1 gallon per head: animals will require 6 gallons for drinking. In tropical countries these amounts would be barely sufficient.

4. In nature, fresh water exists as :—

i. Rain, hail, and snow.
ii. Surface water, found in pools, ponds, lakes, streams, and rivers.
iii. Ground water, found in wells and springs.

23. *Impurities in Water.*

1. Absolutely pure water is not found in nature. It is true that when water evaporates it takes practically none of its impurities with it, but as it falls again as rain or snow it gathers impurities from the air and more particularly from whatever surface is used to collect it. So too, as water flows over the land or through the soil it picks up a great variety of substances which it can hold in solution, or which can be suspended in it; while in the case of surface water dust may be blown into it. By impurity is meant any foreign matter, that is, anything other than

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water; many of the various so-called impurities are harmless, or only harmful if present in very large quantities.

2. In considering the question of the selection and protection of water supplies and the purification of water a clear idea of the object in view is essential. This object is not to reject waters merely because they contain foreign matter or dirt, but to avoid or purify those which contain anything that will cause disease, and by far the most important of the things which cause disease are bacteria.

3. The impurities in water may conveniently be classified as follows:—

i. Those in solution.
ii. Those in suspension, both dead and living.

4. The dissolved impurities consist mostly of salts derived from the soil. The commonest of these are salts of lime, and when present in considerable amount the water is said to be hard. It is difficult to wash with hard water because soap will not dissolve in it; cooking also, especially the cooking of vegetables, is not so efficient if done with very hard water.

Other salts found in water are:—(*a*) common salt, sometimes in considerable quantity in wells near the sea, and quite harmless within the limit at which it becomes unpalatable; (*b*) iron, sometimes in sufficient amount to form a red deposit when exposed to the air, an amount which may be unpalatable but is not likely to injure health; (*c*) lead, the most harmful of dissolved impurities, taken up by certain waters from the pipes in which they flow, a condition which is rare and not likely to be met with in the army.

Dissolved organic impurities also exist in water. They are the final products of the breaking down of vegetable and animal material gaining accidental access to the water, and are present in exceedingly minute quantities.

It is evident that dissolved impurities are seldom of great importance in connexion with water supplies on active service.

5. Dead suspended impurities, when present in any considerable quantity, are easily seen, as they render water turbid or muddy. They consist of anything that the water can pick up when falling through the air, or that it can wash off the surface of the land or out of the subsoil, or that can be blown into it. They may be mineral matters such as clay, fine sand, and mica; vegetable matters such as fragments of wood, leaves, linen, cotton, paper and vegetable refuse of all sorts; or animal matters resulting from the breaking up of carcases of animals and insects, the droppings of animals, and the excreta of man, that is, sewage matters.

6. These impurities, like all foreign matter, are apt to irritate or inflame the lining membranes of the stomach and intestines, causing indigestion, colic, and diarrhœa, and possibly putting the intestinal canal in a more suitable condition to favour the growth of any disease-causing germs that may be swallowed. They also make the

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removal of actual disease germs from water by filtration or by chemical means much more difficult, for in the former case the filters become blocked, and in the latter the chemicals combine with the suspended matters and lose their power of killing germs. Muddy water, too, is unsightly and nauseous to drink, quite apart from any actual harm which it may do. The removal of the dead suspended matters is therefore often a very important factor in water purification, though they are by no means the most dangerous impurities.

7. The other group of suspended impurities consists of living things. An immense variety of low forms of animal and vegetable life are to be found in water, some visible to the naked eye, some microscopic in size; with the few exceptions to be mentioned they are harmless.

8. By far the most important of the living impurities are bacteria. The bacteria which are harmful are those which are the actual causes of certain diseases such as cholera, enteric fever, dysentery, and a form of diarrhœa called infective enteritis. That is to say, those diseases which almost invariably cause the greatest havoc in armies on active service—enteric fever, dysentery, and diarrhœa—may be transmitted from person to person by water, though they may be caught in other ways as well.

9. Amongst living organisms the eggs and embryos (the young) of certain parasitic worms which exist in some waters, mostly abroad, may also cause disease. Any process of purification that will remove or kill bacteria in water will dispose of these.

24. *Sources and Protection of Water.*

1. The following are the main points to be borne in mind when arranging for a supply of pure water for troops in quarters or on the march:—

i. Human contamination is the most dangerous.

ii. In the case of troops in camp or bivouac, contamination is far more likely to come from the troops themselves than to be in the water originally.

iii. Disease-germs do not survive long in water, hence it is recent sewage contamination that is the most injurious.

iv. The greater the dilution of any contamination and the more distant the source the less the danger. For instance, the drainage from one house flowing into a small stream or pond would make the water exceedingly dangerous, while the same amount of drainage going into a big river would have but an inappreciable effect on the water a few miles farther down stream.

2. The general characters of a water as judged by sight, taste, and smell give little or no indication of its capability of transmitting disease, for the disease-germs give no such evidence of their presence. Over and over again, waters which from their appear-

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ance showed no indication of danger have been the cause of outbreaks of cholera and enteric fever.

3. Inspection of the water itself is of little value, and its analysis is impracticable with moving troops, but an intelligent inspection of the source of supply and its surroundings, and of the mode of distribution and storage, will generally show whether it is likely to be safe from human, that is, sewage contamination.

4. *Rain-water.* — Rain-water is seldom used in the army for domestic purposes. The uncertainty of the rain-fall and the difficulty of collecting it free from impurities, except from specially prepared surfaces, make it quite unsuitable unless other sources are not available.

5. *Surface Waters.*—The suitability of surface waters can best be judged by the amount and proximity of any possible sources of human contamination on the land which drains towards them. Small collections of water such as ponds and streams in inhabited places are never fit for drinking purposes without purification, as any contamination which they contain is likely to be of recent origin and will be but little diluted. Lakes of large size generally provide a safe water, for any contamination which they receive is much diluted. Contamination by the troops themselves must be particularly guarded against, special care being taken that the drainage of latrines, urinals, washing-places, trenches in which night-soil or refuse are buried, and of animal lines does not flow into the lake.

"The water supply will usually be marked with flags by the advanced party of engineers:—

White for drinking-water.
Blue for watering-places for animals.
Red for washing or bathing-places.

If running water is not available, a rough barbed wire fence, or some other form of fencing should be placed round the water supply, to keep out animals, which should in this case be watered by bucket or nosebag." (F.S. Regs., Part I, Sec. 57.)

When ponds, tanks, or lakes are used as sources of water supply, the place selected for drawing drinking and cooking-water should be where it is least likely to be contaminated, and preferably where there is a good depth of water so that mud will not be stirred up. Another spot will be set apart for watering animals. Bathing and washing of any description in the lake or pond must be prevented. Water for these purposes must be taken away in empty biscuit tins or other receptacles to selected places from which the drainage will not flow back to the source.

Rivers vary enormously in the purity of their water. This can best be judged of by the character of the country through which they flow and by their size. It may safely be said that no river-water can be considered safe for at least five or six miles below any town whose drainage enters it. When it is necessary to use such water it should be purified in some way.

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"If water is obtained from a stream, horses will be watered below the place where troops obtain their drinking-water, but above bathing and washing-places. Patrolling by mounted men will often be necessary for some distance above the spot where the drinking-water is drawn." (F.S. Regs., Part I, Sec. 57.) The spot selected for drawing water for drinking and cooking purposes should be well above the camp. It should be at a place where the current is good and the depth considerable, and the same precautions should be adopted for marking and safeguarding it as have already been described. A place lower down stream will be marked off for watering animals, and another still farther down for ablution and washing of clothes. If other troops are using the river lower down, special arrangements for washing and watering animals away from the river, similar to those described for ponds and lakes, are often necessary. In a standing camp the water should be pumped, or piped by gravity, into tanks and drawn by taps.

Whatever the source of water supply, "if many animals have to be watered and the frontage is small, hours for watering and the route to and from watering-places will be laid down for each unit. Three to five minutes may be taken as the average time for watering an animal." (F.S. Regs., Part I, Sec. 57.)

6. The yield of streams of considerable size is estimated as follows:—Select 15 or 20 yards where the channel is uniform, straight, and free from eddies. Measure the breadth and the depth at three or more places; from these figures calculate the sectional area. Drop in a chip of wood or cork and time it over the measured distance; this gives the surface velocity, and the mean velocity may be taken as four-fifths of this. The mean velocity in feet per second multiplied by the sectional area in square feet will give the discharge in cubic feet per second, and this multiplied by $6\frac{1}{4}$ is the discharge in gallons per second.

7. *Springs and Wells.*—Of the total rain-fall which reaches the earth, part is evaporated, part flows over the surface to reach streams and rivers, whilst the remainder sinks into the ground until it reaches an impermeable layer of clay or rock. Above this it collects, filling up the interstices of the soil and slowly flowing in a direction determined by the slope of the impermeable stratum, which is generally towards a stream or river. Where this impermeable layer reaches the surface of the ground, the water will flow out and a spring is created. If at another point a shaft is sunk to reach this subsoil water a well is formed.

Wells are generally divided into two classes, shallow and deep; a shallow well being one which taps the subsoil or ground water above the highest impermeable stratum; a deep well, one sunk through an impervious stratum to reach water held up by a deeper impervious layer.

Contamination may reach wells and springs by being washed or dropped into them from the surface, or it may reach them through

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the subsoil; hence any source of contamination on the area drained by them is a possible danger. As in other cases, it is human contamination that is to be feared, and the nearer this is the greater the danger.

The actual distance or area through which contaminating material can travel or spread in the subsoil water varies within wide limits with the nature of the soil, and in the case of wells, with the amount of water drawn from them; but it is never safe to regard this area in the case of wells as less than a circle 25 yards in diameter; in very porous or fissured ground it may be more. The soil acts as a filter, and the number of bacteria found in it diminishes the farther one gets from the surface, very few being found at a depth of five feet; and the farther water travels through the soil the more complete is the filtration. It is obvious, then, that the greater the distance from any source of contamination the less the danger, and that deep wells, the water of which must have come from some distance, are less likely to be contaminated than shallow wells.

In Europe, among the commonest sources of contamination of wells are cesspits and midden-closets, which are holes sunk in the ground to receive sewage. Besides these any foul matters on the ground round a well or spring may get into the water by soakage through the soil. All wells and springs, unless properly protected and closed, are liable to pollution by foul surface water flowing directly into them. Another very common danger is the use of any casual vessel for drawing water; such vessels if coming from dwellings in which there are cases of cholera, enteric fever, dysentery, or diarrhœa can easily infect the water with the germs of these diseases. This is probably a common way in which outbreaks of cholera are to be accounted for in Indian villages.

Where more than one spring or well is to be used the best should be set apart for drinking and cooking-water, and marked with white flags. Others will be marked with blue flags for watering animals and with red flags for washing-water. Washing must never be allowed at springs or wells used for drinking purposes.

All wells should be protected by a fence enclosing an area not less than 25 yards in diameter; in the case of springs on a slope protection need be only at the sides and above. To protect a well from contamination, (*a*) the mouth should be one or two feet above the level of the ground, and the ground round the mouth should be sloped outwards; (*b*) if the well is a small one, the mouth should be closed with a tightly fitting cover with a man-hole in it; and (*c*) a pump should be provided at the side, and not directly over the well; the water being pumped to a tank outside the fenced area and drawn off by taps.

It will be necessary on active service to use wells not completely protected in this way, but much can be done to bring them into line with the above requirements. If there is no pump, one or more buckets must be set apart for drawing water and no other vessels allowed to be put into the well.

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Tube-wells are in many ways superior to sunk wells, for the chances of pollution either from the surface or by soakage from the ground round about are far less.

Springs should be protected in a similar way to wells. The water from a spring should be conducted directly into a closed tank and drawn off by taps. Failing this, or some similar improvised arrangement, a spout or spouts should be arranged so as to obtain the water from the spring. In no case should it be collected in open vessels or in hollows scooped out of the ground, for, if this is done, the water is certain to be fouled either by drainage from above or by persons who come to draw water washing in it, or dipping infected vessels into it. Several outbreaks of cholera have been traced to such a use of spring-water.

If for want of time or for other reason springs and wells cannot be adequately protected, a special water party should be detailed to fill the vessels, all other persons being kept at a distance.

The yield of wells can be estimated approximately by pumping or drawing water so as to reduce the level a measured amount, and taking the time of refilling. The yield of springs is best measured by taking the time required to fill a vessel of known capacity.

25. *Water Distribution.*

1. Water may be contaminated not only at its source but during distribution or storage. In quarters, water is distributed in carts, barrels, or skins (mussacks), in all of which dust and dirt are liable to accumulate. Mussacks, in time, become coated with a slime of decomposing organic matter and it is impossible to clean them properly; they can never be considered proper vessels for distributing drinking or cooking-water. Water-carts and barrels must be frequently cleaned, and periodically disinfected. To enable this to be done they must have sufficiently large openings to allow of every part being reached, and these openings must have dust-proof covers.

Tanks or vessels in which drinking-water is stored should be raised off the ground and provided with taps. In barracks, "tanks used by troops will be periodically cleaned out by the R.E., and cisterns, where accessible, by the troops themselves." (King's Regulations.)

2. Water should never be distributed through camps in open channels.

26. *Purification of Water in the Field.*

1. "As the health of a force depends largely on the purity of the water provided, everything possible must be done to ensure an ample supply of pure drinking-water." For this purpose a certain number of specially trained men are included in each unit, charged with the supervision and purification of the water supply, and the

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care of apparatus and stores provided for the purpose. "Men must be prevented from drinking water that is not pure and must be trained to economize the contents of their water-bottles. Water is best rendered safe for drinking purposes by being boiled, or by the use of sterilizing filters, which must be kept clean, as otherwise they become dangerous. Whenever filters, sterilizers, or other means of purifying water are available, two men per company or corresponding unit should be specially detailed for the purpose of providing pure water." (F.S. Regs., Part 1, Sec. 46.) These men are for fatigue duties in connexion with the water supply.

2. Probably the complete solution of the problem of supplying troops in the field with pure water at all times is hardly practicable.

The surest way to prevent water-borne epidemics is to protect the source of supply. It may, however, sometimes happen that a pure supply cannot be obtained; some method of purification must then be adopted with the object of getting rid of the suspended substances, or of destroying the germs contained in the water.

3. The following are some of the methods for getting rid of suspended matter from water:—

i. *Sedimentation.*—By letting the water stand for a time most of the dead suspended matter is deposited, though some kinds will remain in suspension for a considerable period; one of these is a form of mica which occurs in waters on the Indian frontier and elsewhere. During the process a large proportion of the bacteria are also deposited, and many, especially the disease-causing germs, die out.

ii. *Precipitation.*—By adding certain chemicals, of which the most useful is alum, the rate at which suspended matter is deposited may be hastened. When added to water containing sufficient lime (as all except very soft waters do), it forms a cloud or precipitate which gradually falls to the bottom, carrying with it most of the suspended matter, including many of the bacteria. The amount required is about 5 grains to the gallon, or 1 oz. (a heaped up tablespoonful) for 100 gallons. In the case of very soft waters, one part of lime or carbonate of soda should be added to each two parts of alum. The ingredients should be added slowly and well stirred up.

iii. *Clarification.*—Muddy water can be clarified, either with or without the addition of alum, by pouring it through a bag of flannel (*not* blanket which has been used), cotton cloth, or canvas, suspended from a wooden frame over a bucket. The sediment from the water and the alum, as it is deposited on the cloth, will make the delivery slower but the filtration more complete.

Sand-filters or strainers can be improvised on service, but they must only be regarded as a means for clarifying muddy water. A pit may be dug at the side of a river where the bank is sandy, and the water allowed to percolate through. If the bank is not sandy a

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trench can be dug between the river and pit, boxed in, and filled with sand. Another way, if only a small quantity is required, is to use two barrels, one larger than the other (Fig. 1). The smaller one has holes pierced in the bottom and rests on a bed of gravel inside the other barrel; the space between the two is filled for a foot or more with clean sand, and the water poured on to this. It will sink through the sand and gravel and pass up into the inner barrel. If the bottom of the outer barrel and upper part of the inner one are pierced, as shown in Fig. 2, the filter can then be put into the actual water supply. In this case the filtration is upwards.

The sand must be free from all contamination. To ensure this it should be roasted; neglect of this precaution has actually led to a widespread and very fatal epidemic of cholera.

None of the foregoing methods of purification, however, can be relied on to remove enough of the bacteria to render water that contains disease-causing germs absolutely safe.

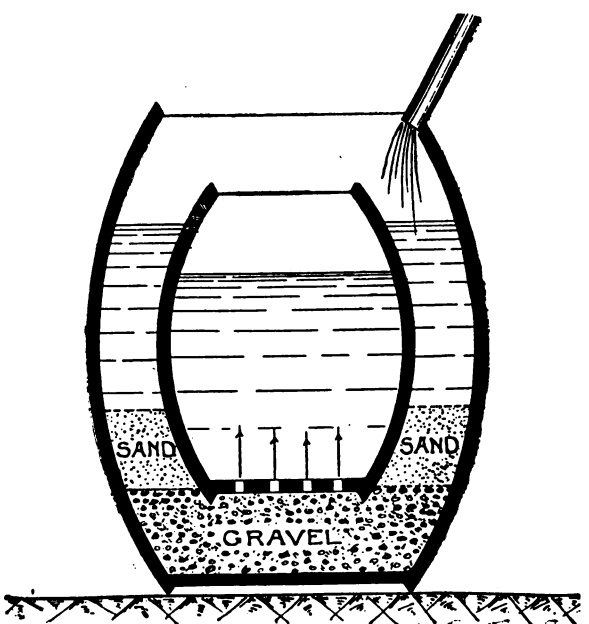

Fig. 1.—Barrel-Filter.

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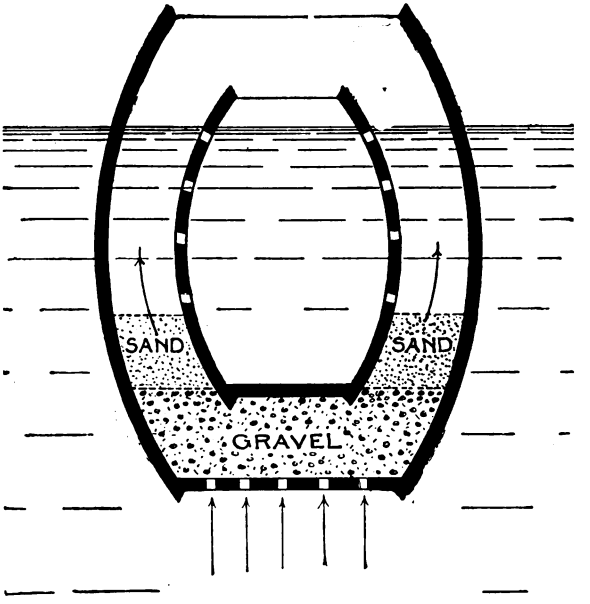

Fig. 2.—BARREL-FILTER, another type.

iv. *Filtration.*—Filtration is really an exaggerated system of straining or clarifying, and aims at purifying water by catching or holding back the smallest particles of suspended matter, including germs, and allowing to pass whatever is dissolved in the water. The only filters that will do so efficiently are those made of unglazed porcelain, earthenware, or similar material, generally moulded in the form of a candle.

The finer the texture of the material the better is the filtration; but on the other hand the output of water is correspondingly reduced. In the service-pattern filter a perforated metal pipe, closed at one end and open at the other, is passed through the candle, the ends of which are closed by metal caps. One or more of these candles is enclosed in a water-tight metal cylinder, with the delivery tube or tubes passing through one end (Fig. 3). Water is pumped into the space between the metal cylinder and the candle, passes through the pores of the candle and is delivered through the central pipe. The pressure employed is 20 or more pounds per square inch.

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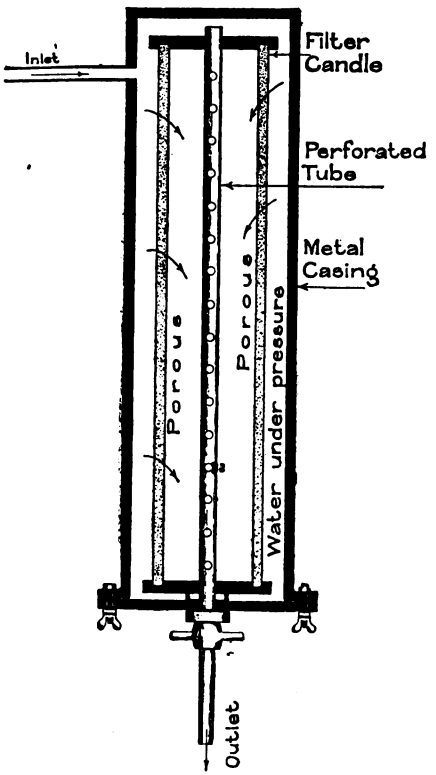

Fig. 3.—Diagram Showing Section of a Porcelain Filter.

The efficiency of these filters depends on the size of the pores of the material of which the candles are made, and this varies in different makes and in different candles of the same make. Not only so, but they may have flaws or cracks, particularly at the junctions of the metal ends with the earthenware, and thereby be rendered inefficient.

The bacteria are able to enter the pores of the candles, but, instead of passing through the walls, they adhere to them. A certain number, however, remain alive and multiply, and after a time, which varies with the quality of the candle, the nature of the water, and the pressure used, will appear in the filtered water. The candles must, therefore, be removed every fourth day, brushed to remove the deposit on the surface, and boiled for one minute to

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kill the germs adhering to the surface and in the pores. The candles are somewhat brittle and liable to break with rough usage.

Muddy water soon blocks the pores of the candles, reducing the output of filtered water, and, though cleaning gives temporary improvement, renders the candles useless in a comparatively short time. The valves of the pump are liable to become scored by the mineral matter in the water; they then cease to act, and grinding the surfaces true again requires a skilled mechanician.

4. The service-pattern filter has been constructed to overcome these difficulties as far as possible. It can be made in three forms, one adapted to a water-cart, a smaller one for pack-transport, and a still smaller one for coolie-transport. All are constructed on the same principles. The water is drawn from the source by means of a hose-pipe and a pump which forces it into a metal cylinder containing material for clarification (including alum); this is to remove as much as possible of the gross suspended matter. From the clarifying-chamber the water is forced into the filtering-chamber.

The filter water-cart has also a main tank for clarified unfiltered water, and a small tank for filtered water. Detailed instructions are supplied with the cart.

5. So far various ways of removing the suspended matter from water have alone been considered. There are two ways of killing the germs in water, viz., by heat and by chemicals; when dead they are no longer harmful and need not be removed.

i. *Heat.*—All bacteria are killed by boiling, though the length of time required varies, some being more resistant than others. The disease-causing germs found in water—cholera, typhoid, and dysentery—are killed by a momentary exposure to boiling water, and, indeed, to a temperature somewhat lower.

Boiling, therefore, at first sight appears a very simple and efficient way of purifying water, but the amount of fuel required, the time expended in heating and cooling the water, and the weight of the apparatus present great difficulties.

For small bodies of troops and on emergencies the cooking utensils can be used; but as a general practice this arrangement is unsatisfactory, as they are required for other purposes, and the cooling of the water is difficult.

To get over these difficulties a number of appliances have been invented, the principle of most of them being what is known as heat-exchange. This consists of an arrangement by which the heated water leaving the apparatus is only separated from the cold water entering by thin sheets of metal; in this way, provided the metal is a good heat-conductor and presents a large surface, and the passage of the water is sufficiently slow, the purified water gives up most of its heat and leaves the apparatus only a few degrees hotter than that at which it entered. At the same time, by utilizing the heat over again fuel is economized.

ii. *Chemicals.*—Proposals have been made at different times to use various chemicals, such as potassium permanganate, lime, copper

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sulphate, chlorine, bromine, iodine, sodium bisulphate, ozone, and others, to kill disease-causing germs in water.

Apart from any actual harm that may result from chemicals in drinking-water, there is a strong popular prejudice against water so treated.

Potassium permanganate has been extensively used, particularly in India, for purifying well-waters during cholera epidemics. As it is quickly destroyed in waters containing much organic matter, the quantity required varies. It is generally used in sufficient quantity to produce a faint pink colour; with average waters this requires less than half a grain to the gallon, which is not enough to ensure that the germs are killed in a reasonable time. If more is used the taste of the water renders it unpalatable.

Chlorine, used in the form of chlorinated lime (bleaching-powder), is useful for purifying water on a large scale. It deteriorates quickly if exposed to the air, light, or moisture, and must therefore be kept in sealed tins. Twenty-five grains of bleaching-powder should be used for every hundred gallons of water. The powder must first be thoroughly stirred in a few gallons of water, and then completely mixed with the bulk of the water to be treated and allowed to stand for at least fifteen minutes. A slight taste is given to the water by the chlorine, but this will disappear after a few hours' exposure to the air.

Both potassium permanganate and chlorinated lime, being relatively non-poisonous, are very useful for disinfecting tanks, water-carts, or other receptacles when they have contained water which is suspected of being contaminated. Sufficient should be added to make a solution of 1-500 of permanganate or 1-1000 of chlorinated lime; every part of the interior should be thoroughly wetted with the solution, and after an hour the water may be run to waste.

6. As regards the relative merits of these different methods of purifying water in the field, heat is the most reliable, and for quarters, such as standing camps or posts, which will be occupied for any considerable time, it is to be preferred to all other methods.

The present official method of purification is filtration by means of the service-pattern filter water-cart, which has been adopted as being the means most generally serviceable under all conditions.

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CHAPTER VI.

FOOD.

27. *General Remarks.*

1. A soldier's food must be regarded from two points of view, (*a*) the actual diseases that may be conveyed by food, and (*b*) the nature and quality of the various food-stuffs, including their selection and preparation so that they will give the best results in nourishing the body.

28. *Diseases which may be conveyed by Food.*

1. Fortunately, the majority of the diseases to which the animals used as food are liable are not communicable to man by eating the flesh; and against those which can be so communicated cooking is a considerable, though not an absolute, safeguard. The commonest affections caused in this way are due to tape-worms, one variety of which is got from beef and another from the flesh of pigs. In the muscles of cattle and pigs they exist in their larval form as little white bladders varying in size from a pin's head to a small bean; they are known as "*bladder-worms*," and the meat is described as "*measly*." They are killed by complete cooking, but, if the meat is eaten imperfectly cooked, they develop in man's intestines into tape-worms of great length.

2. All meat which shows signs of actual disease should be condemned. It cannot have a nourishing value equal to sound meat; and it is by no means certain that such food may not be capable of setting up disease.

3. Milk from tuberculous cows is capable of transmitting the disease to man, and Mediterranean fever is contracted by drinking the milk of goats which harbour the germs of the disease. These diseases have been described already. (*See* Chapter III., Secs. 12 and 15.)

29. *Food-poisoning.*

1. Food-poisoning, or ptomaine poisoning as it is generally called, is a disease or group of diseases caused either by living bacteria in meat or by the poisons formed by them. Sometimes the meat shows signs of putrefaction, at other times none.

Pigs' flesh in various forms, pork, ham, and sausages, has been the most frequent cause of outbreaks of the disease, but butchers' meat, tinned meats, and shell-fish also give rise to it.

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2. The symptoms are generally intense intestinal disturbance, with vomiting, diarrhœa, and great collapse, sometimes indistinguishable from cholera; not infrequently the disease is fatal.

3. The means of prevention are to ensure that food has come from a reliable source, and to inspect it carefully for any signs of decomposition; a clean knife plunged into the interior of a joint will sometimes have a smell of putrefaction when none is evident on the surface.

4. In examining tinned foods it should always be noted if the tin is bulged or "*blown*"; this is the result of gases formed by putrefaction of the contents. The processes by which most tinned provisions are prepared involve one, or sometimes two, holes in the tin; if there are three holes it is an indication that putrefaction has occurred and a third perforation has been made to allow the gas to escape. The third hole is often near the rim and can be felt under the label. A fresh-looking label should not deceive one into believing that the contents are necessarily fresh. Tins are readily perforated by rust, especially if crushed and exposed to the action of sea-water. Such tins should always be looked upon with suspicion.

5. Although cooking is a safeguard against those forms of food-poisoning in which living bacteria are the cause, it is not a certain one, for the temperature in the middle of a joint while being cooked is not always high enough to kill the bacteria; besides which, cooking will not destroy the poisons already formed in the meat, and the bacteria may even have got into it after cooking.

30. *Food Contamination.*

1. It has already been shown how enteric fever, dysentery, cholera, and diarrhœa may be transmitted by means of food contaminated by water, flies, dust, or infected persons; milk similarly contaminated can also convey scarlet fever and diphtheria, the infectious material coming from the throat and skin in the former and the throat in the latter. Milk, indeed, is particularly dangerous, as it is an excellent culture medium for bacteria. The commonest ways in which milk is contaminated are from the hands, etc., of infected persons employed in dairies, from infected water used either for cleaning dairy-utensils or for adulterating milk, and by flies. Many cholera epidemics are caused by infected milk.

2. The preventive measures consist of the protection of food from any of these forms of contamination, before, during, and after preparation. Uncooked foods, generally speaking, are more dangerous than cooked. The strictest supervision over food supplies is necessary; not only over those supplied as part of the ration, but also those produced in Government and regimental bakeries, dairies, and mineral water factories, those sold in regimental institutes, or supplied by contractors or hawkers allowed in barracks and camps.

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3. Aerated waters made from contaminated water, or put in bottles which have been washed in contaminated water, are capable of conveying diseases such as enteric fever and cholera. Alcohol in quantities in which it is taken in even a strong "peg" has no power of killing these germs.

31. *Nature, Quality, and Cooking of Food-stuffs.*

1. The functions of food are the building up of the tissues, and the production of heat and of muscular and nervous energy. A properly-designed dietary, therefore, should be framed with regard to the amount of work to be performed and the amount of body-heat to be produced. Besides being sufficient in quantity, the food must be varied and of good quality, that is, of a kind that can be easily digested. However well designed the dietary and however good the ingredients, the nutritive value will be small if the cooking is not skilfully done.

2. The constituents of which food is composed are classified under five heads:—(*a*) those which contain nitrogen, called proteins, (*b*) starches and sugars, (*c*) fats, (*d*) salts, and (*e*) water.

The two groups, starches and fats, are to a certain extent interchangeable, and it is possible to live in health for a considerable time without starches or sugars. Nansen did so for a winter in the Arctic; but it is questionable if a man could live so long without fats.

3. The foods from which the main supply of nitrogenous substances is obtained are the flesh of animals, birds, and fishes, milk, cheese, eggs, and a few vegetables such as peas and beans. These foods also contain small proportions of some or all of the other food-constituents. These nitrogenous substances go to build up and repair the tissues; they also provide part of the energy and heat of the body.

4. Starches and sugars are chemically very much alike, and are therefore classed together; they exist in almost all vegetable substances. The chief sources of starches are grain-foods such as bread and oatmeal, potatoes, and farinaceous foods such as rice, tapioca, and macaroni. These all contain smaller quantities of the other food-constituents as well as starch. Sugars are of various kinds, for example, cane-sugar and beet-sugar, as well as other kinds which exist in milk and fruits. Starches and sugars are great sources of heat and energy, they are also to some extent transformed into fat in the body.

5. Fats are contained in both animal and vegetable foods, but the chief supply is derived from animal sources, including butter and margarine which is a mixture of fats, mostly animal. Like starches and sugars, fats are sources of energy and heat; they also build up the fatty and nervous structures of the body.

6. The salts are those of lime, iron, soda, potash, and phosphorus; they are contained in the nitrogenous and non-nitrogenous foods in sufficient quantity for the needs of the body.

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7. Water, as before stated, constitutes 60 per cent of the weight of the body. It serves for the solution and conveyance of the food-products to various parts of the body, for the excretion of waste matters, for the equalization of heat, and for the regulation of all the chemical functions. Water is taken into the body not only as a fluid but in all solid foods, of which it forms a large proportion; for example, meat contains 75 per cent, bread 38 per cent, cabbage 92 per cent and butter 16 per cent of water.

8. In addition to a sufficiency of food, it is necessary, in order to maintain physical energy and fitness, that the various food-constituents should be present in proper proportions. In the 24 oz. of food, exclusive of water, which a man requires daily, there should be 4 oz. of nitrogenous substances, 18 oz. of starches and sugars, and 2 oz. of fats. In terms of articles of food this is represented by beef (without bone) 9 oz., cheese 1½ oz., butter 1½ oz., bread 12 oz., potatoes 10 oz., sugar 1 oz., and milk ½ pint. Experience shows that in very cold climates there is a demand for a greater proportion of fats; in hot climates the proportions of nitrogenous foods and fats are instinctively reduced; and on active service there is always a craving for large amounts of sugars and fats, accounted for by the severe physical exertion, and partly, no doubt, by the deficiency which is liable to occur in these constituents in the rations which can be supplied on field service.

9. *Rations on active service.*—On active service a special scale of rations is laid down depending on the circumstances of the expedition. The normal scale is shown in Appendix III. Lime-juice, rum, and tobacco may be added at the discretion of the commander of the force, and ¼ lb. of bacon or 2 oz. of cheese substituted for ¼ lb. of meat. On the Indian scale, cocoa, biscuit, rum, and lime-juice may be added at the discretion of the commander of the force, and jam, bacon, cheese, oat-meal, condensed milk, and preserved fruits substituted for certain of the articles in the scale.

10. In order that men shall have sufficient food to maintain their strength for about 36 hours, even when beyond the reach of supplies, each man carries an emergency food on active service for use in extreme necessity. This is never to be touched unless no other rations of any kind are available, and then only by order of a commander. (*See* F.S. Regs., Part II, Section 41.) It consists of four sticks of chocolate with protein added, in a hermetically sealed tin.

11. *Meat.*—As regards the individual items of the ration issued in peace, the meat, either beef or mutton, should be bright coloured, firm to the touch, and mottled in appearance from the fat interposed between the muscle fibres. The most likely places to look for signs of disease are the chest cavity and to a less extent the abdominal cavity; adhesions of the lining membrane indicate inflammation, probably pleuro-pneumonia or tuberculosis. Excessively fat meat should be rejected, as great loss results in cooking.

The ordinary meat-ration contains about 20 per cent of bone and some superfluous fat. In the process of cooking, meat loses from 25 to 35 per cent; so that of his ration of 12 oz. a man gets about 6 oz. of cooked meat.

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12. *Cooking.*—There are five common ways of cooking meat, viz., boiling, stewing, roasting or baking, broiling or grilling, and frying. In boiling, the meat is put into boiling water which coagulates the albuminous matter near the surface, making a partially impermeable coating which prevents the escape of the juices. After keeping the water at the boiling-point for about ten minutes it is allowed to simmer (150°-170° F.) If it is desired to extract the nutriment, for example, in making soup, the meat is cut up finely and placed in cold water and allowed to soak; the water is then gradually heated, but not allowed quite to reach the boiling point for some time. In stewing, the meat is cut up, a small quantity only of water is used, and the temperature is never brought to the boiling-point. Roasting, properly speaking, consists of cooking joints by the direct heat of the fire; it is seldom used in the army, baking in an oven taking its place; the temperature of the oven is about 400° F. Broiling or grilling is done over or in front of the fire by means of a gridiron; the process is similar to roasting, but the outside of the meat is more scorched owing to the greater surface exposed. Frying is practically boiling in fat, the boiling point of which is approximately 400° F.

13. *Bread.*—Bread is issued from army bakeries at home stations in 2 lb. loaves having crust all round. It is generally delivered between 24 and 48 hours after baking. It should be weighed when cold as it loses weight on cooling, and the loaves should be weighed singly. Good bread should be light and elastic to the touch, no part being without the small cavities caused by the action of the carbonic acid gas in the process of baking. The crust should be of a rich-brown colour, but not burnt, the crumb cream-white; it should not be acid to the taste. One of the commonest faults of contract bread is under-baking, which is done to retain more than the proper amount of water. Bread should be stored in dry, cool, well-ventilated rooms, in such a way that air is admitted freely to all the loaves; this is to allow evaporation of the moisture, without which the bread will become heavy.

Bread is the main source of starch in the soldier's ration; it also contains a small proportion of nitrogenous matter but is practically devoid of fat.

14. *Milk.*—Milk contains all the three principal food-constituents, it is in fact an emulsion of fat, with a nitrogenous curd, and contains sugar and salts in solution. The removal of cream and the addition of water are common. Milk rapidly "turns sour"; this is due to the action of certain bacteria, and comes about more rapidly in warm weather and in dry surroundings. It should therefore always be stored in a cool, clean place, and protected from flies and dust.

15. *Alcohol.*—The fact that alcohol in small doses is oxidized, or used up, in the body seems to be established by experiment. It may therefore be considered a food; but when the amount taken exceeds the equivalent of 1½ oz. of pure alcohol in 24 hours, it begins to be excreted by the kidneys unchanged. This amount of

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alcohol is contained in about three ounces* of ordinary brandy, whisky, gin, or rum, six ounces of the stronger wines (port, sherry, etc.), three-fourths of a pint of the weaker wines (clarets, hocks, etc.), or three pints of the ordinary ales or beers.† When taken in greater amounts than can be used as a food by the body the excess must exert those poisonous effects which the drug is known to possess. Beer tends to fatten and engenders gout and rheumatism. When drunk to any excess it has a retarding influence on digestion and produces the same injuries to health as over-indulgence in the stronger alcoholic liquors; taken in moderation, however, beer is not only an invigorating and refreshing beverage but also a food.

In health, alcoholic drinks are in no way a necessity, and the statistics of insurance companies and other provident institutions tend to show that total abstainers have a better expectation of life than "moderate drinkers."

The sensation of warmth produced by alcoholic drinks is caused by dilatation of the small blood-vessels of the skin; the body-temperature is not raised; in fact, after large doses, it is lowered owing to greater loss of heat from the skin. Both on this ground and from practical experience it is agreed that the power to resist cold is lessened by the use of alcohol. On the other hand, it is beyond doubt that alcohol when taken in any excess in tropical climates predisposes a man to heat-stroke.

The continued use of alcohol in excess leads to degeneration of almost all the tissues of the body, particularly those of the stomach, liver, heart, arteries, and brain. It also renders the body less able to resist the attacks of certain disease-germs, notably those causing pneumonia.

Though it is admittedly quite possible for troops on field service to do entirely without alcohol, yet there are occasions after severe work in inclement weather when an issue of spirits to those used to them will produce a sense of comfort and lessening of fatigue. As alcohol does not conduce to the doing of hard work, the issue should not be made until the day's work is over; it should not be taken fasting, but with the evening meal.

On field service 2½ fluid ounces of rum for British troops, and 1¼ oz. for Indian troops and followers, may be issued at the discretion of the commander of the force on the recommendation of the responsible medical authority.

The United States army includes no alcohol in its war ration. In the German army 1/10 litre of spirits is allowed in the "special field ration"; the French war scale includes 1/4 litre of wine or 1/16 litre of brandy, which may be issued under the orders of the commander in certain circumstances.

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* Wine-glasses vary in capacity, but the ordinary wine glass contains about 2 oz.

† The proportion of alcohol contained in beers varies from 3·5 to 5 per cent, in wines 6 to 17 per cent, and in spirits 40 to 50 per cent.

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CHAPTER VII.

CLOTHING, EQUIPMENT, AND PHYSICAL TRAINING.

32. *Clothing.*

1. The object of clothing is to maintain a uniform temperature of the body. Under normal conditions the temperature of the body at rest averages 98·4° F., and the maintenance of this temperature is an essential condition of health. Heat is produced by the combustion of food and also by muscular work; there cannot be a visible movement of the body without the formation of heat as well, and up to a certain point this production of heat is beneficial. The heat developed is carried by the blood to the surface of the body and got rid of mainly by the evaporation of perspiration, and so long as it is rapidly dissipated no harm results. If in any way this evaporation is interfered with, owing to the air being too damp to take up more moisture, or to the body being too thickly clad, the temperature of the body will rise to an injurious extent and a state of "fever," sometimes ending in heat-stroke, will result.

2. Every officer should realize that such work as marching causes a rise of temperature, and that for bodily comfort the heat so produced must be dissipated. This regulation of the body-temperature is normally effected by adapting the clothing and the work performed to the existing bodily and climatic conditions.

3. Clothing is mainly made up of wool, cotton, or silk. Wool fibres are bad conductors of heat, but have considerable powers of absorption and readily take up sweat from the skin. Silk and cotton fibres are better conductors of heat than wool, but do not readily take up sweat, which accumulates on the surfaces of the garments and when evaporated causes a chilly feeling.

When these materials are made up into clothes, air which is a bad conductor of heat is present between the fibres. Silk and cotton goods do not contain so much air in their structure as wool. For all-round work in temperate climates woollen clothes are therefore the best. They prevent too rapid cooling of the body from excessive external cold, and also cause the evaporation of sweat to take place in an equable manner. If work is done with a high external temperature, and especially when the air is saturated with moisture, woollen clothes may not permit the loss of heat to take place fast enough, and the clothes must be opened to assist the process.

In tropical countries where the temperature is high and the air often laden with moisture, cotton and silk or mixtures of these should be chosen, loose-woven materials being given the preference.

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33. *Equipment.*

1. The equipment of the soldier is of great importance, as it is a powerful factor in the production of heat. The way in which the load is carried should be arranged so as to diminish the work as much as possible. A badly-balanced load means constant muscular effort to maintain the equilibrium of the body, and constant muscular effort means constant production of heat; in this case unnecessary heat. For this reason the weights should be arranged as close as possible to the centre of gravity of the body, which in an unloaded man is a little below the navel and vertically below the point of the shoulder. The total load carried by a man must always be considered in relation to the actual body-weight of the man himself. As long as it is not too heavy, practice will train the muscles to carry it and still keep sufficient energy in store for any other purpose. The limit which can be so carried appears to be about one-third of the body-weight. When that limit is exceeded, carriage of the load becomes the man's main function and his fighting powers suffer.

34. *Physical Training.*

1. The object of physical training is to develop the recruit's strength, agility, and capacity for work, and in the case of the trained man to maintain them at a proper level. The build of a youth's body depends chiefly upon the characteristics of his ancestors; but his individual peculiarities have been confirmed by a growth of seventeen years or more before he enlists. He is then no longer so plastic as the boy, and will be injured rather than improved by too rapid and vigorous attempts to alter the shape and carriage of his body.

2. The principle of progression from easy exercises of short duration to more difficult exercises of longer duration is essential. Most recruits have been out of employment before they enlist, and in many cases they have not received sufficient food, nor had sufficient healthy exercise for the proper development of their bodies. During their first month of service they require plenty of food and light exercise.

3. Unusual movements are not the most suitable, for they produce an amount of fatigue and an expenditure of energy which are out of all proportion to the results. Many of the exercises found in systems of physical training are based upon the idea that all the muscles must be uniformly developed, and with this end in view positions which are never used in ordinary life are constantly assumed. The uniform development of all the muscles of the body is unnecessary and uneconomical.

4. A constrained and rigid attitude hinders the action of the heart by restricting the free movements of the chest which aid the passage of the blood from one side of the heart to the other. Such an attitude is, moreover, wasteful of nervous and muscular energy.

The position of attention should be one of alertness without strain. In marching the natural movements of the arms and the swing of

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the body should not be suppressed. A soldier ought to march in the manner most economical of physical exertion, in order that he may husband his strength and be capable of a great effort whenever the demand may be made.

5. So-called breathing exercises are unnecessary. The rate and depth of breathing are determined by the condition of the blood, and are adjusted to such a nicety that no artificial method can ever be an improvement. Nasal breathing is normal during rest and slight exercise, but it is wrong to insist on such a form of breathing during hard work; mouth-breathing under such conditions is natural, for it offers less resistance to the passage of air to the lungs and also assists in cooling the body.

6. The natural method of improving the "wind" is progressive running. A good "wind" is the capacity of the heart and lungs to accommodate themselves to the demands made upon them by muscular work. Training, in short, is the training of the heart, and if during the process the heart of a healthy man becomes weaker or disordered in its action it is probable that the training is bad.

The idea that artificial expansion of the chest gives freedom of action to the organs within is erroneous. The walls of the chest are moulded on the viscera they contain.

7. Training involves the accommodation of the recruit to an outdoor life. Work in the open air "hardens" a man, diminishes his liability to colds, and improves his appetite and digestion; advantages which physical training inside the gymnasium does not possess in a like degree.

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CHAPTER VIII.

HYGIENE OF THE MARCH.

35. *General Remarks.*

1. The hygiene of the march is a matter which calls for the earnest consideration of every officer and soldier, as mistakes apparently trivial may often have far-reaching effects. These mistakes have their origin for the most part in the action of individuals. Their remedy lies not so much in the issuing of orders as in the inculcation of knowledge and a sense of responsibility in the mind of the soldier himself. Given the knowledge as to what is right, the soldier must stand or fall by his own actions.

2. In preparing for a campaign or a series of marches, care must be taken that only fit men form part of the columns. All cases of disability should be left behind, since such soldiers are certain, sooner or later, to become encumbrances to the moving force. This applies especially to the detection and elimination of concealed or partly-cured venereal disease.

36. *Time, Length, and Speed of the March.*

1. The chief work of the infantry soldier is marching. Marching means walking at a certain fixed pace, wearing certain clothes, and carrying a certain load: each of these factors is beyond the control of the individual soldier. The hour of starting and the length of the march are dependent on military needs, the weather, etc. "Men must get as much rest as possible. If an early start is contemplated, no man should stir till ordered to turn out. Preliminary arrangements for breakfast should be made over-night." (F.S. Regs., Part I, Sec. 46.) An essential preliminary to every march is to see that the men do not start on empty stomachs. A light meal of tea or coffee with bread or biscuit is quite sufficient; this is particularly desirable when the men move off in the early dawn, as at such times a little food and a warm drink does much to increase resistance to disease. The usual custom is to march in the early morning, so as to complete most of the march before the heat of the day comes on. Night marches are likely to be more frequently used in the future than in the past; but before making use of a night march the loss of sleep and the fatigue which it involves should be taken into account.

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2. As to the length of the march, a force of the size of a division under normal conditions should cover from twelve to fifteen miles daily. Much more than this can be done, but a greater daily average than fifteen miles is rarely achieved, except by small bodies of men and for short periods. The severity of a march, however, is not to be measured so much by its length in miles, as by other factors, such as the weather, the state of the roads, the pace, the load carried, and the formation of position in the column.

3. The rate at which a march can be done depends largely on the size of the command. An infantry battalion will cover a fifteen-mile march in about five hours, but an infantry brigade will need nearer six hours for the same distance, and a division will require even more. The question of individual ease when on the march is complicated by the fact that the movements of the soldier are to a certain degree constrained; the weak man has to keep up with the strong, the man of short stride with the one of long, and the very regularity of step tends to make military marching wearisome. As far as possible, the individual soldier should not be hampered by restrictions of an unnecessary nature. Thus, in hot weather, men should be encouraged to unbutton their coats, turn them well back, and present as few obstacles to free expansion of the chest as possible. When weights or loads are carried, the length of the step must be shortened; attention should be paid to the way in which the pack is put on, and the men should be taught to take them off at halts. The formation and position in the column are details of great moment to the individual. On dusty roads, close order is particularly trying to the foot soldier, and for this reason infantry should move on as wide a front and in as open a formation as circumstances permit. Without ventilation through the ranks, the air soon becomes very foul.

37. *Mental Occupation.*

1. Straggling on the march may be the result of lack of discipline, or fatigue. It is an evil which demoralizes the men and must be firmly repressed. Probably the surest way of preventing fatigue is to occupy the minds of the men.

With this object every encouragement should be given them to sing or whistle favourite tunes, even if there is a band.

38. *Foot-soreness.*

1. The proper care of the feet is mainly a matter for the individual soldier. At the same time, supervision by the officer is also necessary. All should realize that, for the prevention of injury to the feet by marching, well-fitting boots and socks and clean feet are essential. Ablution of the feet at least once daily should be compulsory for troops in the field. If facilities for washing the feet are not available, wiping them, particularly

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the toes, with a wet cloth does good by removing dirt and grease. Excessive sweating of the feet may be relieved by bathing in a solution made by diluting one ounce of formalin with two pints of water. For the same purpose, soaking the feet in water coloured red with permanganate of potash is useful. These remedies are at best but palliatives: the real remedy for foot-soreness lies in the provision of a well-fitting boot and a soft, smooth sock to cover the foot.

2. Much of the soldier's difficulty turns on the fact that his socks are apt quickly to shrink and become so shortened that the heel of the sock tends to come under the sole of the foot, causing creases. Men should be taught to stretch their socks when they take them off; also at the end of a march to shake them out, and after stretching them to put them on the opposite feet. If there are tender parts of the feet the inside of the socks should be greased with soap where they fit over them. In cases where the socks are obviously ill-fitting, and where no spare pair is available, it is better for the men to leave them off, and simply cover the feet with an ordinary newspaper. If the foot be placed in the centre of a page, the paper can be wrapped round it so as to make an excellent substitute for a sock. This covering will protect the foot for a day and can be readily replaced. When blisters or chafes arise, they must be appropriately treated; the blisters should be pricked with a clean needle*, and tender parts covered with soap or clean grease.

39. *Smoking on the March.*

1. The habit of smoking has an important bearing upon the ability of men to march. Its practice undoubtedly has a deleterious effect on men engaged in a serious physical effort. This arises from the disturbing effect of tobacco upon the nervous control of the heart, combined with a tendency to make men dry-mouthed and consequently thirsty. Men should therefore be discouraged from smoking when marching. The reasons for this discouragement should be explained, and it should be especially impressed on them that cigarette-smoking is the most harmful form.

40. *Water Discipline.*

1. A common fault, even among experienced soldiers, is a too free recourse to the contents of their water-bottles, and a tendency to drink each time they approach water. Arbitrary control over the use of the water-bottle on the march should be avoided; endeavours should rather be made to develop a proper sense of water self-discipline. Much can be done to prevent the sensation of thirst by carrying a pebble in the mouth to excite the flow of saliva, as well as by breathing through the nose rather than through the mouth. Tobacco-chewing, to a greater degree than

* A sewing-needle can be quickly sterilized by holding the point for a few seconds in the flame of a match.

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smoking and spitting, tends to increase thirst. Before starting on the march the water-bottle should be filled with approved water or unsweetened tea or coffee. At all halts near water the quality should be determined by the medical officer, and on his verdict should depend whether the men's bottles are refilled or not.

2. It is the duty of officers to exercise a supervision over the general cleanliness of their men's water-bottles and the regimental water-tanks. Washing out with boiling or very hot water is the most rational method of cleansing the bottles, but on field service this may be impracticable. For similar reasons, the use of permanganate of potash or other chemical is not always a practical procedure. The next best thing to do is to fill the bottles with very hot tea at least once a week, and leave this hot liquid in the bottle for at least an hour; but to be of any use the tea must be poured into the bottles in as near a condition of boiling as possible. The practice of attempting to scour out the inside of a bottle by placing stones, sand, or gravel in it and then shaking, followed by washing out with water, should be discouraged: the sand or stones are usually dirty, and the last state of the water-bottle will be worse than the first. In circumstances where there is an ample supply of clean water, the ordinary washing out with three or four fillings of this water is a reliable procedure, but this and similar methods must be carried out under intelligent supervision. Water should never be kept in the bottles when the water-bottle is not in daily use.

41. *The Halt.*

1. A short halt will be ordered soon after the column has started. In the case of both mounted or dismounted troops, subsequent halts are arranged at regular intervals at the discretion of the commander of the column, who should let commanders of units know how often they may expect halts, and their duration. (*See F.S.* Regs., Part I, Sec. 31.) Some care needs to be exercised to prevent men getting chilled on these occasions if the men have been perspiring freely and there is any breeze blowing. With halts of any length, the most important sanitary question is the need of sanitary police to control and prevent the casual fouling of the vicinity of the halting-places by men who retire to ease themselves. Areas should be allocated to which the men may resort, and piquets or sanitary police placed over them to see that the men cover up all excretal matter deposited there.

2. As soon as the halting-place is reached, the sanitary personnel of units should proceed at once to the areas allotted and prepare urine-pits and shallow latrine-trenches, and should remain and see that those resorting to these trenches use them properly. Immediately the "fall in" sounds, they should fill in the trenches and pits, replace turf, and leave the spot clean, tidy, and whole-

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some. Strict discipline is needed at all halting-places to prevent the wholesale fouling of wayside areas.

The sanitary measures to be taken on arrival in quarters are described in Chapter X.

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CHAPTER IX.

BARRACK SANITATION.

42. *Over-crowding.*

1. Disease increases from over-crowding. Whether the infection is spread through the air, by personal contact, by water, by food, from latrines, or by insects, the more people there are in a particular area, for example, in a barrack-room, billet, or tent, the larger will be the number that come within the range of possible infection, and the more concentrated will be the dose. For instance, if 50 men live in one barrack-room and one of them is suffering from consumption, any of the remaining 49 are liable to catch the disease; but if the number is halved only 24 will be exposed to infection. The same is true of infection spread in other ways. The effect which faultily-designed and faultily-constructed barracks may have in propagating disease at once becomes apparent.

43. *Ventilation.*

1. One of the most important points in the construction and arrangement of barrack-rooms is ventilation, which may be defined as providing the inmates with pure air.

2. Air is a mixture of gases, the principal of which are oxygen and nitrogen. Other constituents are carbonic acid gas, water-vapour, dust (often carrying bacteria and other organisms), organic matter, and minute traces of other substances.

Of these constituents, oxygen is indispensable for the life of all animals, in whose lungs it is absorbed by the red blood-cells, carried by the blood to all parts of the body and taken up by the body-cells. Nitrogen takes no part in the nutrition of animals, though both oxygen and nitrogen are necessary to plants.

3. The action of breathing by human beings and animals uses up some of the oxygen of the air, while carbonic acid gas and water-vapour, in addition to other impurities which are classed together as organic matter, are exhaled. Besides this, human beings who carry infection of certain diseases distribute disease-germs to the air.

4. Apart from the actual disease-germs which it may contain, air which has been robbed of some of its oxygen and contains an excess of carbonic acid gas is actually harmful, for carbonic acid is a poison

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which causes fatal results when air containing five to ten per cent of it is inhaled.

5. The results of careful research show that it is necessary to change the air of a room three times every hour in order to keep it pure. The cubic space allowed for each soldier in barracks at home is 600 cubic feet. With a smaller cubic space it would be necessary to change the air more often, but in cold climates this cannot be done without causing discomfort, unless the incoming air is warmed. Moreover, besides having sufficient cubic space, each man should be separated as far as possible from his neighbours; indeed the superficial area allowed is probably more important than the cubic space. This is obvious when it is remembered that the most dangerous impurities of the air are discharged with the breath.

The allowances of cubic and superficial space are shown in Appendix IV.

6. In barracks at home stations, fresh-air inlets are arranged at a height of about eight feet above the floor; by this means, the air enters above the heads of the inmates and does not cause a draught, and, as it is gradually colder and therefore heavier than the air inside, it gradually sinks, displacing the warmer impure air which rises to the top of the room where outlets are provided. Care must be taken to see that these ventilators are not blocked and that their shafts are kept clean.

7. Without machinery for pumping or extracting air, ventilators cannot be relied on to keep up a constant current; they only do so when the difference in temperature between the air inside and outside the building is considerable. The cracks and crevices in windows and doors, and the chimneys of a room all aid in ventilation, while an average sized grate with a brisk fire burning will extract about 10,000 to 20,000 cubic feet of air each hour. In addition to any other means of ventilation, windows should always be partly opened on one or both sides of the room, night and day, for by this means far more complete change of air can be effected than by the ventilators. It is laid down in King's Regulations that "the windows of every barrack-room will be opened sufficiently to allow of free ventilation, and will be kept open as far as the weather and season admit."

8. In huts, and in many barracks abroad, the ventilating openings are arranged along part of the ridge of the roof, or under the eaves, the openings being covered with wire-gauze.

44. *Personal Cleanliness.*

1. Personal cleanliness is of the highest importance, and involves not only attention to the skin, but to the nails, hair, mouth, and other parts of the body. The skin is a covering for protection, and for getting rid of water in the form of sweat. This latter function is increased by exercise as well as by warmth and other causes. If sweat be continually allowed to remain and dry on the skin, or soak

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into the clothing, it soon becomes irritating, unhealthy, and offensive. For these reasons we wash our bodies to remove, not only coarse dirt which we can see, but also the dried sweat which we cannot see. The act of washing further improves the skin, opens and cleans its pores and keeps it sweet and healthy. Most persons wash their hands and faces, but men must not forget those parts covered by clothes. Of these, the following should be washed every day if possible:—(*a*) between the legs and buttocks; (*b*) the arm-pits; (*c*) the feet and toes. In addition, a bath once or twice a week is necessary, but it should not be taken within two hours of finishing a meal. After bathing or washing, the skin should be well rubbed and dried, as this prevents a chill and improves the circulation of the blood. The hands should always be washed before eating, and care should be taken to clean the nails. Dirty nails and fingers are a common means of conveying infection. It is a simple but important matter to keep the nails in good order; finger-nails should be cut round and toe-nails straight across.

2. The hair must be kept closely cut, be brushed and combed daily, and frequently washed. Pomades and grease are, as a rule, unnecessary.

An article of kit which requires attention is the hair-brush. It should be washed at least every three weeks. Soap or hot water should not be used, but the brush rinsed in a basin of cold water to which has been added a teaspoonful of washing soda; this will remove all dirt and grease. It should be dried by shaking or swinging round, and then put in the sun or wind.

3. The teeth should be cleaned at least once, if possible twice, a day by rubbing with a brush. Sometimes the gums are soft and inclined to bleed; even if this be the case the teeth should still be cleansed. The best time to use the tooth-brush is before going to bed, so as to remove particles of food adhering to the teeth after the evening meal. The mouth should be washed out with water both morning and evening. Decaying or painful teeth should receive appropriate treatment, and on no account be neglected.

45. *Washing of Clothes.*

1. Clean clothing is infinitely connected with the care of the skin. Dirt from the clothes reaches the skin, and dirt and sweat from the skin soak into the clothing. For these reasons, it is important to change and wash underclothing at least once a week. The same clothes should not be worn by day and by night; with a little management, every soldier should be able to keep a shirt and pair of drawers for night wear. Socks get dirty very quickly. Every man should have two pairs in use, one for the morning and one for evening wear; there should also be two pairs for the wash. Unless care be paid to details of this kind, it is impossible to keep the feet hard and clean. Underclothes can be cleaned by brushing, shaking, and exposing to the air and sun. This is nearly always possible,

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even when washing cannot be managed, as, for instance, in camp and on the line of march.

2. In some foreign stations the washing is done by natives, sometimes in water grossly polluted. After washing the clothes, the ironing, etc., should be carried out under proper supervision. Otherwise it is possible that the clothes may be taken to the washermen's huts, and stored in the confined space occupied by families none too cleanly in their habits, some of whom must from time to time be suffering from infectious diseases which may easily be spread in this way.

3. Blankets and bedding very quickly become dirty under the conditions of barrack life; and they are articles which retain infection for considerable periods. Their regular and efficient washing is therefore very important. At home stations, blankets are changed and washed annually; sheets and pillow-slips fortnightly. In India, blankets and bedding in regimental charge are washed under regimental arrangements, the mattresses and pillow-cases by the soldiers themselves. Such of the extra-issue blankets supplied during the cold season as are returned dirty or stained are washed under the direction of the supply service. In a country where diseases easily conveyed by bedding are rife, it would be well if all blankets returned into store were washed, and whenever possible disinfected in a steam-disinfector.

4. In cases of infectious disease, articles of bedding and clothing are not to be returned into store until disinfected (*see* King's Regs. and Chapter IV, Sec. 20); but, as it is sometimes not possible, until a man has been in hospital a few days, to tell whether his disease is an infectious one, the clothing of all men admitted to hospital should be kept separate, but not in the barrack-room, until it is known that they do not require disinfection

46. *Barrack-room Cleanliness.*

1. Cleanliness in the barrack-room is another means of preventing disease. The infectious germs of some diseases can remain alive attached to particles of dust for a considerable time, and therefore the mere stirring up of dust by means of a dry duster or brush, for it either to settle again or be inhaled by the occupants of the room is both useless and harmful. Dusting should be done with a damp cloth rinsed out from time to time in water, and should never be done just before a meal is to be eaten in the room.

2. The sluicing of a quantity of water over floors should not be allowed, they can be cleaned with a wet mop or cloth rinsed out in a pail of water. Occasionally they will require scrubbing, but this should be done with soap and a minimum of water. The custom of putting blankets on a wet floor to save a few foot-marks is a dirty and unhealthy practice and should be forbidden.

3. The desirability of keeping a special room set apart for meals is now well recognized, and provided when possible.

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4. The fouling of food in barracks is not uncommon. The following rules should be observed :—

i. Food should not be stored or kept in barrack-rooms. If it must be kept there, it should be placed in a covered jar or other receptacle.

ii. The hands and clothes of all persons who handle food or cooking utensils should be scrupulously clean.

iii. All bread and meat stores should be clean, well ventilated, and inaccessible to flies.

iv. Kitchens and their fittings, such as tables, shelves, as well as cooking-utensils should be kept clean and tidy.

v. Flies, which carry minute portions of filth and germs on their feet, contaminating all they touch, should as far as possible be prevented from gaining access to kitchens. They breed only in filth, and where there are many flies it is a certain sign that there is filth and dirt in the near neighbourhood.

vi. Cooks and their assistants must be personally clean, and wear clean, washable over-clothing.

vii. Men should not be allowed to act as cooks, mess-orderlies, or in any capacity connected with the serving of food, if recently recovering from any infectious disease, more especially from enteric fever.

5. A sufficiency of cloths for washing up should be provided, and all those used in the cook-houses or sculleries should be washed daily and dried. All dishes, knives, and other utensils used at meal-times or for food storage should be cleaned on a table, and not placed on the floor or taken to outside taps. For scouring tea-cans, etc., clean bath-brick kept in a tin for the purpose should be used. The use of casually collected sand should be forbidden.

47. *Conservancy in Barracks.*

1. Under King's Regulations, a commanding officer "is responsible that the duties laid down in the Regulations for Engineer Services, Part I—Drainage Section—are performed with regularity by the troops. A sanitary manual—Instructions in the Care of Barracks—is issued to units for guidance in the more technical part of the duties." "The cleaning of surface-drains and catch-pits and the flushing of latrines, where skilled labour is not required, will be performed by fatigue parties." (King's Regulations.)

2. *Disposal of Refuse.*—Kitchen-refuse must invariably be placed in the special receptacles provided for the purpose. As far as possible, liquid and dry refuse should be kept distinct; but in both cases the receptacle must be kept covered in order to avoid smells and to prevent the access of flies to the contents. Its removal from barracks must be performed daily.

3. *Latrines and Urinals.*—"Attention will be paid at all times, and especially during the prevalence of epidemic disease, to the state

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of the latrines and urinals, and to the disinfecting of ash-bins. A C.O. will issue special orders that improper articles are not thrown into them or into the drains." (King's Regulations.)

The proper use and care of latrines is of the first importance, as, if neglected, these places rapidly become centres for infection. In most barracks at home, water-carriage of sewage is available and the flushing is done either automatically or by hand. In the newer barracks, ordinary water-closets with individual flush-tanks are provided, and it is the duty of every user of these closets to see that the contents of the pan are properly washed away by pulling the chain of the flushing-tank. Another detail requiring attention is that of using paper torn or cut to a size not larger than that of an ordinary hand. In all well-regulated barracks suitable toilet-paper is provided, but in spite of this it is not unusual to find large sheets of newspaper thrown into the closet-pans. The very bulkiness of these masses of paper prevents the pan being properly cleaned and facilitates rapid clogging up of the discharge pipe. For the same reason pieces of cloth, rags, and other articles of the kind must never be thrown into a water-closet, the proper place for these waste products is the ash-bin.

4. In a few places at home and in most garrisons abroad, the dry-earth closet exists; the usual arrangement being the provision of a pail or portable midden placed under an aperture in a seat, with a box of dry earth, from which, by means of a scoop, the user covers over the excreta. Special care should be taken to throw a sufficiency of the dry earth over the filth in the pail in order to obviate the smell, and to prevent flies gaining access to this objectionable material. The pail contents must be removed daily.

5. No matter whether it be a water or dry-earth closet, all woodwork and fittings must be kept scrupulously clean. The seats must be scrubbed daily with soap and water, the scrubbing including both the upper and under surfaces of the seat. The pans or pails must be kept clean, and where earth-closets are in use, an adequate supply of finely-powdered, dry soil and a sufficiency of scoops must always be available. The pails must fit closely under the seat. If there is a gap between the top of the pail and the seat, the floor is certain to be fouled. The floor must be suitably sloped, and made of some hard, impermeable material. Enough pails must be available to allow those which have been fouled to be cleaned. This will be best secured by first washing out the contents with water, drying and airing by exposure for a few hours to the sun if possible, and then scrubbing over the inner surface with the cresol solution supplied for the purpose by the barrack department. The coating of these utensils with tar is objectionable, as it renders them unsightly, and tends to conceal rather than remove dirt.

6. Urinals should be managed on similar lines to latrines. Those of porcelain or glazed earthenware must be adequately flushed with water either automatically or by hand, while those made of slabs of slate must be wiped over twice a week with sufficient "heavy oil"

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to impart a greasy surface. Well-managed latrines and urinals should be devoid of smell and free from flies, even in warm weather. The presence of flies in these places is a sure sign that something is wrong. For night convenience, fixed urinals on the stairway-landings are gradually replacing urine-tubs immediately outside each barrack-room. These urinals are kept locked during the day. Urine-tubs, if used, must be treated in precisely the same way as closet-pails. Their contents need to be carefully emptied each morning, with special precautions taken to see that no splashing or spilling occurs on the landings or stairways. If such does occur it should be immediately dusted over with dry earth and the place swept clean.

7. All men engaged in the handling of urine-tubs, or in the care and cleaning of urinals, closets, or latrines, must remember that they are handling dangerous material capable of giving infection to either themselves or others, often both. To reduce these risks to the lowest point, men engaged on these duties should carefully wash their hands immediately on completion of the work, and certainly before they handle food. No men employed in cook-houses or as mess-orderlies should ever be allowed to have anything to do with the removal of urine-tubs or with the care and cleansing of urinals or latrines.

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CHAPTER X.

FIELD SANITATION.

(See Field Service Regulations, Part I, Chap. IV.)

48. *Sanitation in Quarters generally.*

1. "Quarters take the form of Billets, Close Billets, Bivouacs, and Camps.

Billets are the usual form of quarters in civilized countries, when not in immediate proximity to the enemy. They allow of proper rest, and give shelter from the weather, but usually cause dispersion of the troops. This disadvantage may be partially overcome by resorting to Close Billets, when as many men as possible sleep in houses, the remainder bivouacking.

Bivouacs give concentration and readiness, but are trying to the health of men and horses, and should only be resorted to when tactical considerations make it imperative to do so.

Camps admit of concentration, and are more healthy than bivouacs, but will only be used on service by troops engaged on field operations in exceptional circumstances. Huts may replace tents if a force is likely to remain halted a long time, as for instance in a siege or blockade." (F.S. Regs., Part I, Sec. 45.)

In the presence of the enemy, tactical considerations are of the first importance, and determine the form of quarters to be adopted. "When not in proximity to the enemy, the health and comfort of the troops are the first consideration." (F.S. Regs., Part I, Sec. 45.)

2. It is a matter of experience that, as long as communities are small and scattered, men can live under very primitive conditions and yet not suffer unduly from infectious diseases. When, however, populations become crowded in towns and cities, costly sanitary undertakings become an absolute necessity if epidemic diseases are to be avoided.

3. Quarters, more especially bivouacs and camps, are a reversion to primitive conditions, but at the same time, in all forms of quarters, large numbers of men are kept far more closely crowded together than in barracks. For military and administrative reasons, the area of quarters is contracted as far as possible; in billets, especially in close billets, overcrowding is a necessary feature, while the minimum space

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allowed an infantry battalion in camp is at the rate of 500 men per acre, or more than in the most crowded parts of London. But it is not so much the density of population per acre as the crowding together in billets or tents that is important. A bell-tent with its full complement of 15 men allows 12 square feet and 32 cubic feet per man, against a superficial space of 60 and a cubic space of 600 feet which he gets in barracks.

It is well known that troops spending a short time only in any one camp are almost always healthy; but the longer a camp or bivouac is occupied, the more disease occurs in it.

4. When it is recollected that diseases are spread from person to person by defective conservancy, personal contact, and infected food and water, it is evident that the conditions of life in quarters are almost ideal for encouraging their dissemination. To prevent this, the greatest care and attention must be paid to sanitation. "Every officer is responsible that all orders affecting the health of an army are rigidly carried out by the troops under his command. **Neglect of sanitary precautions inevitably results in great loss of life and efficiency.**" (F.S. Regs., Part I, Sec. 46.)

5. It is desirable to emphasize the fact that the sanitary control of quarters depends for success on attention to details and the exercise of care on the part of individuals. These are required not only of the men, but also of the officer; for there can be little doubt that the men take their cue from the officer. The essential principle of sanitation in quarters, as elsewhere, is *cleanliness*. This state of cleanliness must not only be maintained while the quarters are occupied, but on evacuation the area must be left sweet and tidy, so that those coming after may not suffer from a heritage of filth. The absence of flies is the surest index of cleanliness, for if there is no filth to feed upon flies will not be present.

Sanitation in Billets.

49. *General Instructions.*

1. "The local authorities should usually be required to take such sanitary measures as may be needed, but it may be advisable to give them assistance, particularly in close billets, in which the construction of additional latrines, watering and washing places will often be necessary. Billeting parties should invariably ascertain the source of the local water supply, the measures which may be necessary to guard it from pollution, the sanitary system of the place, and should make inquiries as to the existence of infectious diseases. Sentries should be posted at the first opportunity over houses where infection exists, and over any other houses in which it is not desirable to quarter men." (F.S. Regs., Part I, Sec. 53.)

2. The foregoing information should be obtained by the officer in charge of the billeting party or parties from the mayor, chief officer of police, or other official holding an equivalent position, when handing to him the billeting demand.

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50. *Accommodation.*

1. "Billets without subsistence can be provided at the rate of about 10 men per inhabitant in rich agricultural districts, and at the rate of about 5 to 6 men per inhabitant in town or industrial districts. No data can be given for close billets, in which men for whom no shelter can be provided must bivouac." (F.S. Regs., Part I, Sec. 50.)

As regards the nature of the accommodation afforded, "cover is all that officers and men have a right to expect in billets on active service" (F.S. Regs., Part I, Sec. 52), and any premises suitable or which can be readily made suitable for human occupation may have to be used.

2. When billets are being inspected and marked prior to the arrival of troops, the local authorities should be asked to take steps to render as suitable as possible such premises as may not be in a sanitary condition; for example, by opening doors and windows to give free ventilation, sweeping out or scrubbing any uncleanly floors, etc., according to circumstances and the time available; assistance, if necessary, being given by the troops. Should it be impossible to render certain premises sanitarily safe, and no others be available, the troops allotted should bivouac.

3. In distributing men to the rooms of houses in a billeting area, it is desirable from a sanitary point of view that the following numbers be not exceeded, namely, in rooms over 15 feet wide, but under 25 feet, not more than two men for every yard of length, or in rooms 25 feet wide and over, not more than three men for every yard of length. This amount of accommodation should suffice for one night; but even so much cannot always be expected, the areas allotted and the premises in them must be utilized to the best advantage.

4. From the necessary overcrowding it is obvious that great attention must be paid to ventilation (*see* Chapter IX, Sec. 43) in order that the evil results of breathing impure air may be minimized. Windows, and if necessary doors, should be kept open as much as may be feasible without causing hardship.

51. *Precautions against Infectious Disease.*

1. The importance of safeguarding the troops from infectious diseases which may exist among the inhabitants is emphasized by the instructions quoted from Field Service Regulations. Similarly, the inhabitants should be safeguarded from infectious disease should it occur among the troops. The measures necessary for preventing the spread of infection have been described in Chapter IV, Secs. 20 and 21.

52. *Water Supply.*

1. The protection of water supplies has been described in Chapter V, Secs. 24 and 25. Protection may be necessary not only against accidental or careless pollution on the part of the inhabitants or troops but, possibly, also against damage or wilful pollution on the part of evilly-disposed persons.

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53. *Sanitary Arrangements.*

1. While the municipal conservancy system of a modern town should generally suffice for the troops billeted in it, at any rate for a short period, additional sanitary, especially latrine, accommodation will usually be necessary, particularly in close billets. Additional watering or washing-places may also be needed. In the event of a prolonged occupation special conservancy measures will be required.

In all cases the local authorities should be consulted, if possible, so that the improvised or special arrangements made may be suitable for the sanitary system of the town.

The construction and care of improvised sanitary arrangements will be described when dealing with sanitation in bivouacs, temporary camps, and established camps.

"When the same billets are to be used by successive bodies of troops, it is of the utmost importance that they should be left scrupulously clean. In such cases arrangements should be made to supervise and, if necessary, assist the local authorities in this work after the departure of the troops." (F.S. Regs., Part I, Sec. 53.)

Improvised sanitary arrangements, if to be maintained for the use of successive bodies of troops, must be left in a thoroughly clean condition; or, if no longer required, should be dismantled or filled in as the case may be, and the sites marked and pointed out to the local authorities.

Sanitation in Bivouacs and Temporary Camps.

54. *Selection of sites for Bivouacs and Camps.*

1. "At the end of a march, a staff officer, usually accompanied by some mounted police, will be sent forward to select, in conjunction with an engineer and a medical officer, and with due regard to tactical considerations, water supply, etc., the ground where the force is to pass the night. He will make all necessary arrangements for the reception of the troops on their arrival." (F.S. Regs., Part I, Sec. 56.)

2. On active service, the site of a bivouac or camp is mainly determined by military necessities, the proximity of water, and the facilities for obtaining fuel, grass, and other supplies. The health of troops may indeed be considerably affected by the site selected; yet it must be remembered that diseases such as enteric fever, dysentery, and diarrhœa are usually brought by the troops themselves, and the extent to which they spread depends much more on the interior economy of the camp or bivouac than on the physical configuration of the ground.

3. Camp and, if possible, bivouac sites should be selected as if for continued occupation, and should be large enough to spread the troops out as much as military necessities permit. Sites recently occupied by other troops are to be avoided, as possibly the soil and the water have been polluted; but a month or two will remove all danger of infection from this source. Inquiries should always be made as to the existence of infectious disease in the neighbourhood.

4. High ground with good drainage and covered with grass or low vegetation is to be desired. Steep slopes should be avoided, but gentle

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slopes facilitate drainage. Large woods with undergrowth, low meadows, the bottoms of narrow valleys, and newly turned soil are apt to be unhealthy. Ground where the water is near the surface is objectionable, and if there is any likelihood of rain, so are situations at the bases of hills, in ravines or dry river-beds, as the camp may be flooded or at any rate become unhealthily damp. Clay soils are undesirable, and dusty soils lead to much discomfort and are believed to play a part in the spread of a number of diseases; the extent to which the person, the clothes, food, and water become covered with dust lends support to this view.

5. In malarious countries, the neighbourhood of water in which mosquitoes are likely to breed, and of native habitations, is to be avoided.

55. *Water Supply.*

1. "A good water supply is essential, but considerations of safety may necessitate a camp, or bivouac, being placed at some distance from it." (F.S. Regs., Part I, Sec. 55.) "The military police, or in their absence the first troops to arrive at the halting ground, will mount sentries on all water likely to be required for use, with such orders as will prevent any form of pollution. These sentries will not be withdrawn until permanent water guards are detailed. The water supply will always be selected in conjunction with the sanitary or other medical officer, who will satisfy himself as to its fitness for use." (F.S. Regs., Part I, Sec. 57.)

2. The selection of water supplies and the steps that should be taken to protect them from contamination have already been considered in Chapter V (Secs. 24 and 25), but it is necessary to emphasize the importance of carrying out immediately on arrival measures for securing adequate protection. This is far the most important safeguard against water-borne disease and the one most apt to be overlooked.

If the camp or bivouac continues to be occupied, the makeshift arrangements for supply which have to be adopted at first must be replaced by better methods as soon as possible.

56. *Arrangements on Arrival of Troops.*

1. "When ground is allotted, each commander must be informed of any localities or depots outside his own area on which he may draw for water. It must also be made clear to each commander which roads he is at liberty to use, and what special defensive, police, or sanitary measures he is to take. The place to which dead animals are to be dragged, and how they are to be disposed of, must also be described." (F.S. Regs., Part I, Sec. 56.)

2. As soon as possible after arrival in a bivouac or camp, the preparation of latrines, urine-pits, and other sanitary arrangements should proceed. Some of these may be of a temporary nature, if only to preclude casual resort and consequent rapid fouling of what otherwise should be a clean and wholesome area.

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3. The duties of the sanitary personnel in this connexion include provision of the following :—

i. A sufficiency of latrines for one day for (*a*) officers, (*b*) non-commissioned officers, and (*c*) men.
ii. A urinal for (*a*) officers, (*b*) non-commissioned officers, and (*c*) men.
iii. A series of urine-pits at the end of the lines for night purposes, or a urine-pit to receive the contents of the night urine-tubs if they are used.
iv. The necessary drains and pits for the disposal of waste water.
v. Straining-pits or traps for greasy water, namely, one for each cooking-place, one for the sergeants' mess (when established) and one for the officers' mess.
vi. Such refuse-pits or incinerators as may be needed.
vii. Drains for carrying off excess water from stand-pipes (if these are provided), and around ablution or washing-places.

57. *General Sanitary Arrangements of Bivouacs and Camps.*

1. "The shape and size of camp or bivouac will, subject to the following general rules, be determined by the ground.

In brigade and larger encampments, one main centre and one main cross street will run the entire length and depth of the camp.

Units should not be cramped for space more than is absolutely necessary. On the other hand the dimensions of a camp or bivouac must not be increased unduly, as a straggling camp entails extra fatigue duties and delay in circulating orders." (F.S. Regs., Part I, Sec. 61.)

2. "Where bodies of troops are cramped or bivouacked close together, the general position of the latrines and kitchens of each area will be settled by superior authority, in consultation with the senior medical officer; that is to say, it will be decided whether they are to be in front, at the rear, or on the flank of an area." (F.S. Regs., Part I, Sec. 56.)

3. In warfare in uncivilized countries, "the position of night latrines must be arranged in accordance with the requirements of the tactical situation, but whenever possible they should be outside the perimeter, under charge of sentries. Day latrines must be further away but within the line of piquets." (F.S. Regs., Part I, Sec. 155.)

58. *Disposal of Refuse.*

1. The refuse of a camp or bivouac consists of kitchen-garbage, bits of crockery, tins, paper, and rags. It must never be allowed to be thrown casually on the ground; special receptacles should be provided for it. In bivouacs or camps of a temporary nature, these receptacles may take the form of pits or holes; but where these are employed, the contents must be covered over with at least six inches of earth two or three times a day to prevent flies being attracted to them. Pits of this nature should be suitably marked, and located near kitchens and at the end of each line of tents or sleeping places.

2. If the site is occupied for several days, burial of refuse will probably not suffice. In these circumstances, incinerators (*see* Sec. 68) should be constructed; but care must be taken that they are so situated as not to cause offence to any adjacent units.

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59. *Disposal of Dead Animals.*

1. The problem of how best to dispose of dead animals may assume serious proportions in time of war. There are two possible methods of disposal, namely, burning and burial; but unless special furnaces are available the burning of the large carcasses is impracticable. The second alternative is almost equally difficult of accomplishment. It takes considerable time and labour to dig a pit big enough to hold one dead ox, and when it becomes a question of doing this for a dozen or more similar animals it is unlikely that sufficient men will often be available. In these circumstances, the only course is to disembowel the animals, bury the viscera deeply, and leave the empty carcass to be disposed of by nature. The defects of this procedure can to a certain extent be minimized by stuffing the remains with straw or other combustible material and setting light to it. This will not consume the carcass, but it will do something towards drying it up and lessening the evils consequent on its subsequent gradual disintegration. In many cases, improvised crematories can be built on which the bodies of animals can be burnt, and every endeavour to do so should be made in all camps.

60. *Disposal of Excreta.*

1. The proper disposal of this material is vital to the sanitary interests of all, and presents fewer difficulties than might be expected. It has been pointed out that as soon as a unit occupies the bivouac or camp site selected for it, it is the duty of the sanitary personnel to prepare latrines and urinals without delay in the area allotted for that purpose. If the construction of latrines is unavoidably delayed, selected places should be marked off for the reception of excreta to which men should be directed to go. At the earliest opportunity all excrement so deposited must be buried or covered with earth by the sanitary personnel.

"Latrines, urinals, refuse-pits, cattle lines, etc., must be situated at least 100 yards from, and when practicable to leeward of, the water supply and kitchens. They must never be placed in or near gullies which, when it rains, discharge into the water supply, nor in any situation the drainage or filtration from which may possibly reach, and so pollute, the water supply." (F.S. Regs., Part I, Sec. 60.)

2. *Latrines.*—Latrines, as stated above, should be located to leeward of the bivouac or camp and in such a position that no possible fouling of the water supply can result. The assistance of the sanitary officer, or such other officer of the medical service as may be exercising sanitary supervision of the command, should be obtained when the exact position of these places is being selected. Latrines and urinals should be as far removed from the part occupied by the men as is compatible with convenience; under ordinary conditions this may be put at 100 yards. The latrines must be placed as far as possible away from the kitchens and other places where food is prepared or stored. Where natives are employed, special latrines for them are necessary.

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3. The extent of latrine accommodation provided will vary according to whether the area is for temporary or permanent occupation; in bivouacs it should be three per cent, for ordinary camps it should be five per cent. These figures may be taken to represent either yards or actual seats, according to circumstances. The multiplication of latrines is undesirable, as one or two fairly large latrines are easier to control than several smaller ones, and the pollution of the soil is more localized.

4. For temporary quarters, the usual latrine is a trench with or without a seat. These trenches may be either long and deep or short and shallow. The latter are always preferable, but the former may be required if there is not enough ground for shallow trenches, as, for example, when the minimum camp space has to be occupied for several days, or when additional latrine accommodation is required in billets, and space is restricted.

5. If the long-and-deep trench system be used, a trench 5 yards long, 3 feet deep, and 16 inches wide is the necessary allowance for each hundred men. The greatest care should be taken to prevent the water supply being fouled by these trenches, either directly by soakage, or indirectly by surface water in wet weather flowing from the trench or its immediate neighbourhood. With this system "the contents of latrine trenches should be covered with a couple of inches of dry earth daily. The use of kerosene oil and lime will assist in keeping flies away." (F.S. Regs., Part I, Sec. 60.) The great difficulty about latrines of this kind is the fact that the front edge of the trench soon gets wetted with urine and the front of the latrine rapidly becomes a urine-sodden quagmire, the mud from which gets carried back into the lines or tents on the men's boots. In the not remote chance of there being one or more undetected cases of enteric fever among the command, the possibilities of infection from this source are not difficult to imagine.

6. To remedy this, it is preferable to dig not one long trench but a series of short, parallel trenches, across which the user straddles, and readily directs both solid and liquid excreta clear into the cavity, without soiling the sides. The trench on the short-and-shallow system should be 3 feet long, 1 foot deep, and 1 foot wide, and the interspace between each trench not more than 3 feet—preferably 2½ feet if the nature of the soil permits—so as to preclude the men using the trench otherwise than in the straddling attitude. These short trenches are far cleaner than the long type, they entail less labour to dig, and are more efficiently filled up and renewed. If available, a seat in the form of a stout pole can be laid at right angles to the trenches supported on forked uprights. A back-rest may be formed by a similar pole, but is often omitted.

7. It is usual to allow 5 short and shallow trenches for every 100 men; but when the numbers of men are 500 or upwards, 3 per cent of trenches suffice, that is, 500 men need no more than 15 trenches. As a rule, a trench lasts only one day. A trench can be made to last longer if the contents, which tend to get heaped up in the centre, are levelled off, and if the earth used for covering the excreta be finely

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broken up. The interspace of 2½ feet is ample when the soil is firm, and allows plenty of room for another trench to be dug in it. A 3-foot interspace gives more room between trenches, but entails a longer frontage and a correspondingly greater length of screen. In stiff clay the interspace cannot be used on the second day, as the urine, not being able to soak away, keeps the ground soft. It may generally be used a week later if necessary.

8. The method of laying out these short and shallow trenches will be gathered from Figs. 4 and 5. Supposing the number of men for whom

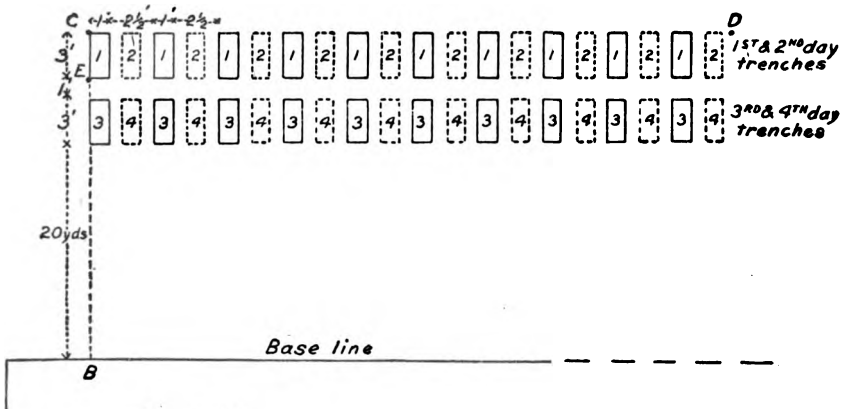

FIG. 4.—DIAGRAM SHEWING HOW TO LAY OUT TRENCH-LATRINES.

latrine-trenches are required is 200, and the probable length of occupation is 30 days, for this small number we must allow 5 per cent, or 10 trenches daily. The frontage in yards required daily may be taken to be six times the number of hundreds of men present, that is 200 men will need 12 yards of latrine frontage. The depth for latrine area is two-thirds the number of days' stay. In this case, the occupation being probably 30 days, the required depth will be two-thirds of 30, or 20 yards.

Next, suppose B (Fig. 4) is the base-line of the camp, measure off 20 yards at right angles to B, and drive in a peg at C. From C, take the line CD parallel to the base of the camp and 12 yards long. This line CD equals the line of the first row of trenches. From C, along CD, measure off 1-foot and 2½-feet spaces alternately, marking the spots with a spade till there are ten 1-foot spaces. From C, measure 3 feet, CE. From E, and parallel to CD, mark off alternate spaces as before and join up. This outlines the first row of trenches. Next, remove the upper sod of each trench, in one piece as far as possible, and put it about three feet behind the trench (Fig. 5). Excavate the

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trenches till they are a foot deep, keeping the sides vertical, and placing the excavated earth immediately behind the trenches between it and the sod. This earth must be finely broken up.

9. The latrines should, if possible, be surrounded with a canvas screen, the back being 3 feet behind and the fore-part at least 6 feet in front of the trenches, with an entrance in the centre of the front having a 6-foot overlap (Fig. 5). The length of screening necessary for 1,000 men on a 5 per cent basis will be 130 yards; if 25 trenches are used, they will require 70 yards.

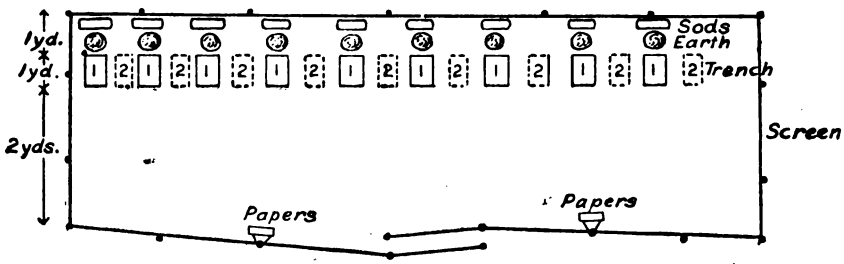

FIG. 5.—DIAGRAM SHEWING HOW TO ARRANGE LATRINES IN CAMP.

10. On the second day, fill in the trenches with the remaining excavated earth, replace the sods, tread and beat down firmly. Dig the second day's trenches in the interspaces of the first row. On the third day, dig a row of trenches similar to and parallel with the first row and one foot in front of them. Move the screening forward so as to surround them properly. Repeat the construction of trenches on the subsequent days in a precisely similar manner. After the latrine has been prepared, examine the slope of the ground, and, if necessary, dig a shallow drain to divert surface water from the trenches, taking care that it does not flow on to the ground in front of the trenches which will have to be used later on. This precaution applies also to urinals.

11. For covering the deposited excreta with earth, some kind of implement such as a spade, scoop, empty tin, or tin-lid should, when possible, be provided near each trench. Kicking the earth in with the foot is certain to be a failure and should be discouraged.

12. The proper administration of the latrine system is a most important factor in the preservation of the health of men living in quarters. There is one rule for the successful working of these places, and that is that all excreta must be covered up as soon as possible with earth, not only for mere purposes of deodorization, but to preclude the access to it of flies, which are one of the chief means of conveying the germs associated with this filth to man and his food. In bivouacs or

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camps, where the ordinary trench-latrine only exists, a satisfactory solution is not an easy matter. In the first place, the available soil is inconveniently placed, the provision of a sufficiency of spades or scoops is not always practicable, and the surroundings of the place conduce to hurry on the part of the individual. The remedy lies in educating the men to realize the necessity for covering up their own excreta with earth, and in placing a sanitary patrol, drawn from the unit as a whole, over the latrines with orders to inspect them at short intervals and see that a sufficient quantity of earth is being used. The condition of all latrines should be verified personally by the orderly officer of the day at least once during each twenty-four hours.

13. So soon as the latrine-trenches have been filled in to within six inches of the ground level their use should be discontinued, earth thrown in, and the turf or sods replaced. On the abandonment of a camp or bivouac, all latrine trenches must be filled in and the site marked with the letter L made with staves or other suitable means.

14. *Urinals.*—"Urine may spread infection. Men are on no account to urinate elsewhere than in the latrine-trenches, or in urinals or pits set apart for the purpose. Receptacles, such as empty biscuit tins, should be placed at convenient spots close to the tents at night, to be used as urinals, to prevent pollution of the ground." (F.S. Regs., Part I, Sec. 60.)

In all bivouacs and camps where receptacles are not provided, pits or trenches must be dug for the purposes of urination. For day use, these urinals are best placed adjacent to the latrine-trenches and within the screen, if supplied. Given a reasonably absorbent soil, the urine soon disappears; but if this is not the case care must be taken to make supplementary pits. In any case, the urine-sodden soil must be covered at least three times a day with clean, dry earth to protect it from flies. For night use, when urine-tubs of some sort cannot be provided, or when the day urine-pits are some distance from the tents or sleeping places, it may be necessary to dig shallow urine-pits near the men's lines into which they can micturate at night; but this practice should be resorted to as rarely as possible, and the pits must be carefully filled in at dawn. Urine-tubs can easily be extemporized from empty biscuit or oil-tins, which may with advantage be partly filled with grass, sawdust, earth, or any other absorbent material. These tins should be mounted on heaps of earth or stones on boxes, or on rough wooden trestles, to reduce to a minimum all chance of splashing or spilling.

15. The best type of camp urinal takes the form of one or two shallow trenches, at least 2 feet wide, leading into a pit filled with large stones; the trenches being for urinating into, and the pit to take the excess which fails to soak into the soil. Roughly, two trenches, each 8 feet long, will suffice for a battalion of full strength. The trenches should have a fall of one inch to the foot. The catchpit will vary in depth and size according to the soil and the number of men using the trenches; one 3 feet deep and 8 feet in diameter in a moderately porous soil should suffice for 800 to 1,000 men. Fig. 6 shows an example of one of these urinals. The trenches will last about two days

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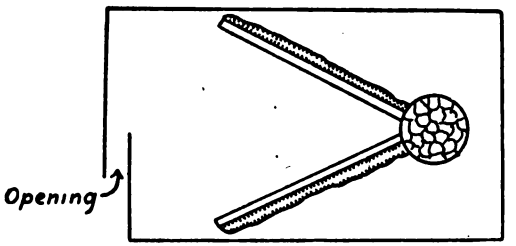

FIG. 6.—PLAN OF CAMP URINAL.

and the pit some eight days; when foul, new trenches can be dug as radii from the pit and the old ones filled in. If feasible, the pit should be screened off to prevent men actually micturating into it. The ground around a urinal should be burnt when another has to be dug or the quarters evacuated.

61. *Tents.*

1. Experience goes to show that, except in extremes of climate, the absence of tents does not seriously affect the health of well-clothed and well-fed troops. When tents are used, "a trench should be dug immediately under the curtain of each tent and the excavated earth banked on the outer edge of the trench. The curtain should then be pegged to the inner slope of the trench, the canvas thus draining into it. Surface drains should be constructed to prevent rain-water lodging in the trenches. Half an hour's work on the first wet day, when the natural run of the water can be seen, will do more to keep the camp healthy than a day's work in dry weather." (F.S. Regs., Part I, Sec. 61.)

2. In the circular tent, ventilation is provided by three small openings at the top. In some of the Indian double-fly tents, openings are specially provided to facilitate ventilation, but even with these it is not possible to change the air sufficiently often to keep it pure. "Tent flies are to be looped up the first thing every morning, in wet weather on the leeward side only," and bedding exposed to the sun and air whenever possible, as these are most useful disinfectants. "In a standing camp, tents will be struck periodically, and the ground underneath well swept and left exposed for some hours at least, the tents being eventually replaced on their former sites. Tents should never be pitched for occupation in the intervals. Tent doors should generally face away from the prevailing wind; in mounted units they should face the horse lines." (F.S. Regs., Part I, Sec. 61.)

3. Whenever it can be avoided the men should not eat food in the tents, for fragments always collect on the ground where they decompose and attract flies.

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Sanitation in Established Camps.

62. *General Instructions.*

1. "When laying out a standing camp, tents, at the required intervals and distances, should be dressed both from the front and flank; main and cross streets should be maintained for the purposes of communication. A system of surface drainage should be constructed.

Care should be taken to prevent the pollution by latrines or refuse-pits of ground within 100 yards of the encampment, or any possible extension of it. An improvised pail system of removal should be established if possible.

Incinerators for burning dead animals, refuse, etc., should be constructed. Horse and cattle lines should be cleaned regularly, dung removed, and special precautions taken to prevent ground in the neighbourhood of kitchens and washing-places becoming fouled. Flies are a constant source of disease, and great care is necessary to prevent them from breeding in dirt and refuse, and from coming in contact with food.

Camping grounds should be definitely allocated for mounted troops, dismounted troops, and convoys, respectively. Infantry camping grounds should not be used by mounted troops." (F.S. Regs., Part I, Section 63.)

2. The sanitary arrangements of established camps require careful organization and administration, without which the areas are certain, sooner or later, to become infected (generally by the troops themselves) with the germs of such diseases as enteric fever and dysentery.

3. In endeavouring to secure thoroughness and completeness in all sanitary arrangements, it may be advisable to detail permanent fatigue parties, or to organize civilian labour for sanitary work under military supervision.

4. Much that has been written regarding sanitation in bivouacs and temporary camps is equally applicable to established camps; certain sanitary measures more suitable for permanent than temporary camps are described below.

63. *Arrangement of Camping Area.*

1. When the troops remain for any length of time in one locality, much of the success or failure in regard to efficient sanitary control of an encampment depends upon the arrangement of the area. This again largely depends upon the extent of land available. In a camp, assuming that the space is equivalent to that officially laid down, the various sanitary arrangements to be described later, such as incinerators, latrines, and urinals, should be located in the rear of the tents in what may be termed the "sanitary area." As a general guide as to how to

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arrange such an area, Fig. 7 may serve as a type. Conditions vary so much that no fixed plan is possible, but each case must be judged on its merits.

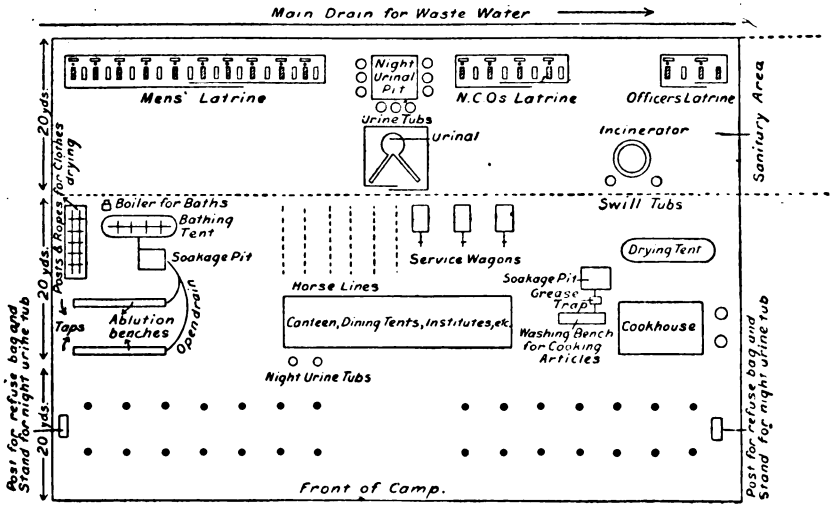

FIG. 7.—PLAN OF CAMP.

64. *Kitchens.*

1. These places require constant supervision to ensure the removal of remains of food and greasy water without delay. The most important details which need attention are:—(*a*) That the kitchens and washing-places be so located as to be handy for water, but remote from latrines, urine-pits, or other receptacles for refuse and garbage. (*b*) That all sullage-water be made to pass readily away; this will usually be effected by passage into soakage-pits, or if this does not suffice, then by suitable trenches. This waste water is greasy, and if allowed to pass directly on to the soil soon makes a felt-like scum, which not only impedes the soaking-in of the water but also attracts flies. A good plan is to fill the reception-pits or the upper ends of the drainage-channels with coarse brushwood, bracken, or gorse, which catches and holds the grease and other organic solids, allowing the clearer liquid to run freely away into a soakage-pit, the earth at the bottom of which has been loosened by a pick. (Fig. 8.)

2. An alternative plan is the following:—Take two large biscuit-tins and place one inside the other, the inner one resting on two or three stones so as to leave a space between it and the outer one (Fig. 9). The

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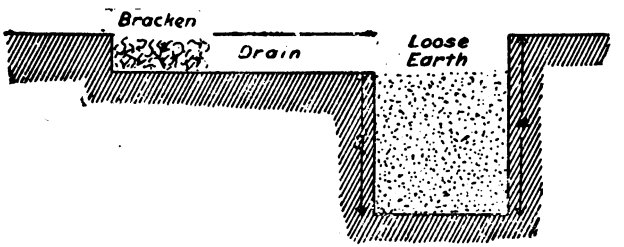

FIG. 8.—GREASE-TRAP FOR CAMPS.

inner one serves as a coarse strainer, and the outer to direct the water over and into a small pit filled with grass, heather, or brushwood, which acts as a grease-trap. From this small pit, cut a shallow trench leading to a large soakage-pit. The lower tin can be given a spout, conveniently made by cutting an inverted U or V-shaped flap from one of the sides, turning down, and rounding off.

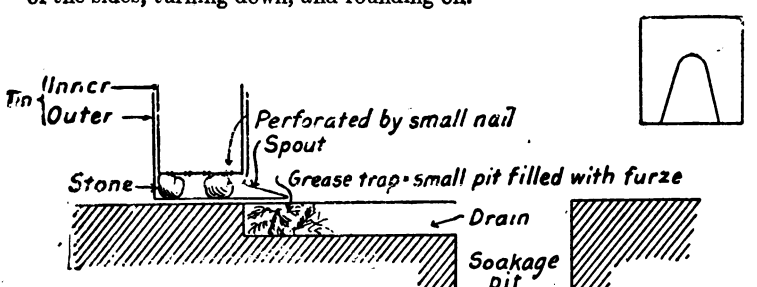

FIG. 9.—GREASE-TRAP FOR CAMPS.—*Inset showing method of cutting spout.*

3. A modification of the foregoing can be made by turning a box upside down over the pit or grease-trap, and cutting a hole in the bottom into which is fitted a piece of perforated tin (Fig. 10).

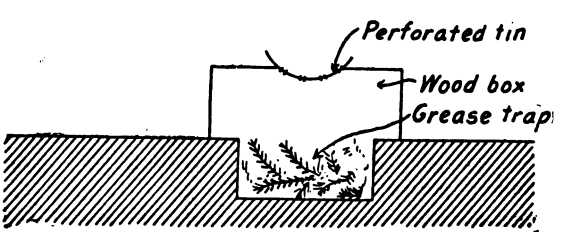

FIG. 10.—GREASE-TRAP FOR CAMPS.

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4. In all cases, the furze, grass, or brushwood used to catch the grease must be burnt and renewed daily.

5. At each kitchen or mess there should be a place provided for cleaning up utensils. This should have a table, or boxes to serve as a table, a straining-pit, a sufficiency of clean cloths, and a plentiful supply of hot water. If sand is used for cleaning vessels, it should previously be baked over a fire, and kept in a tin or box near the cleaning-bench. Ashes from a wood-fire may be used in place of sand. The whole process should be supervised by one of the sanitary personnel.

65. *Ablution-places.*

1. Ablution-places should be located conveniently near the men's lines or tents, and the soiled or soapy water drained away on similar principles to those indicated for kitchen sullage-water. In camps, where ordinary ablution-benches with foot-gratings are available, care must be taken to prevent the adjacent ground becoming sloppy. Whether benches are available or not, the waste water must be run away quickly and tidily; the arrangement for drainage shown in Fig. 11, modified according to the fall of the ground, will be found to

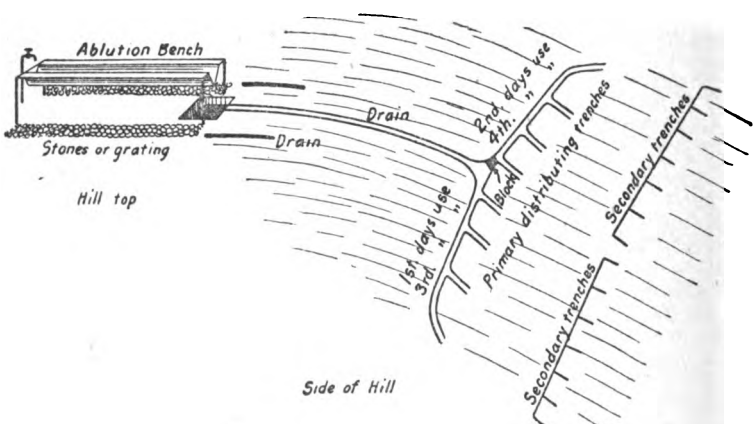

FIG. 11.—ABLUTION-PLACE AND DRAINAGE IN CAMP.

meet the requirements of most cases. This work should be carried out by the sanitary personnel.

2. In semi-permanent and standing camps, the men should be given facilities for baths. Thus a large tent or marquee can be divided by canvas screens, each compartment containing a seat, a foot-grating, and a

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tub or tin bath. The bath can be fitted with a wooden plug and made to discharge over a trough of galvanized iron, or it can be emptied by tipping into a conveniently cut drain (Fig. 12).

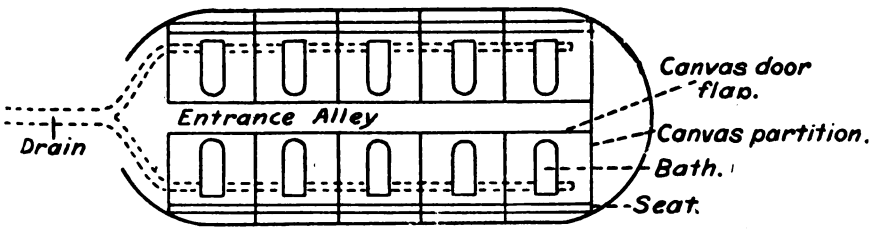

FIG. 12.—BATHS IN CAMP.

Another suitable arrangement is shown in Fig. 13. Even an ordinary bell-tent provided with tubs, and a soakage-pit with a drain leading to a larger pit outside, will do. Unless facilities of some kind

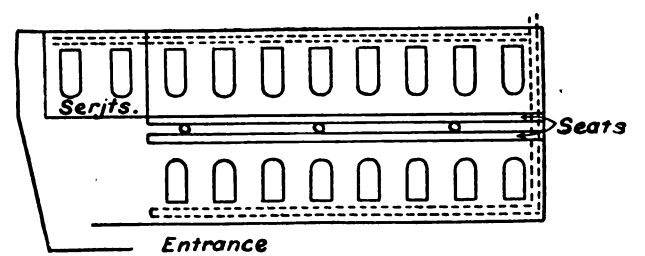

FIG. 13.—BATHS IN CAMP.

for obtaining a decent bath are provided when possible, a high standard of personal cleanliness cannot be expected of the soldier.

66. *Disposal of Waste Water.*

1. Unless the soil and the gradients favour rapid absorption and drainage of all waste water, it will be advisable either to shift the kitchens and washing-places every few days or to collect this liquid in water-tight receptacles. Such receptacles should be placed on raised platforms, and the contents should be emptied daily outside the camp area. Before being returned to use, they should be cleaned and rubbed with a cloth soaked in crude creosote.

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67. *Drying of Clothes.*

1. Although the wearing of wet clothes conduces to less ill-health than many suppose, still a great deal of personal discomfort will be avoided if some simple means of drying them when there is no sun or wind can be devised. The following is one method:—Pitch as large a tent as is available, dig one or more holes, some two feet deep and three feet in diameter, within the tent sufficiently far from the poles and canvas to minimize the risk of fire. Line the holes with fairly large stones, and carry them up so as to make parapets round the hole, some feet high. If a fire be lighted in the hole and carefully tended, the stones will soon radiate a good deal of heat. The wet clothing should be hung round the hole as well as the appliances on the spot will allow, and the tent shut up. In place of a tent, a rough shelter can be built, or use made of some outhouse on a farm.

2. An alternative plan is to rig up a simple framework, as shown in Fig. 14, by means of ropes, cords, or wire. This should be erected either within a large tent or under some shelter, and one or more

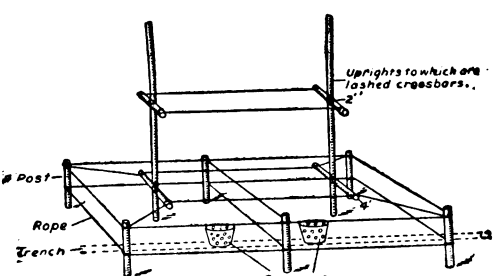

FIG. 14.—FRAME FOR DRYING CLOTHES IN CAMP.

braziers, improvised from buckets or tins, full of glowing coke or charcoal, placed at suitable intervals near to the wet clothing.

68. *Disposal of Refuse.*

1. In camps of a permanent nature, all refuse should be placed in closed metal receptacles, the contents of which are removed and disposed of daily, as explained for sullage-water. In the absence of metal receptacles, dry refuse may be put in sacks hung on posts at the end of the lines, while kitchen-garbage can be collected in tubs, barrels, or boxes, raised on stands close to the cooking-places. If it can be avoided, solid and liquid refuse should not be mixed.

2. Carts or other vehicles used for the removal of refuse should be designed so as to prevent any escape of their contents. If removal is arranged for by civil contract, close supervision must be exercised to see that there is a sufficiency of suitable tubs or receptacles with covers

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that the removal is made daily in proper carts, and carried out at definite times during daylight when the movements of the scavengers can be followed. The supervision and management of all refuse-receptacles is a part of the duties of the sanitary personnel.

3. The final disposal of kitchen-garbage and camp-refuse is a matter of great difficulty, particularly on field service. The location of the place should always be outside the inhabited area, to leeward of the prevailing wind, and remote from the source of water supply. There are two possible methods of dealing with this refuse, burial and burning. The former is suitable where the amount of material to be disposed of is not excessive; but when much refuse is present the labour necessary to dig sufficiently large pits is almost prohibitive. In this case as much as possible should be destroyed by fire, and what is not burned must be buried.

4. Theoretically, burning is the ideal mode of disposal in all cases, but practically the natural dampness of the material makes it difficult. The methods for the cremation of refuse vary from the use of the company kitchen-fire to the employment of specially constructed incinerators. Various portable destructors have been used in camps; but for the general requirements of field service, none can be said to be satisfactory.

5. Where available, the use of a little mineral oil will much facilitate the destruction of garbage by fire. In other cases, the construction of a simple grate of iron rods placed on turf supports is often successful in maintaining a brisk fire when fed with camp-refuse. In any devices of this kind, the great essential is to secure a draught of air under and through the material to be burnt; the damper the mass the greater the need of air. Once the fire is started and a draught secured, it will burn provided it is not fed too quickly with damp refuse.

6. A simple refuse-destructor can be made by digging two shallow trenches intersecting each other at right angles; each trench should be 9 inches deep and 9 inches wide where they cross, getting gradually shallower and wider towards the ends. The length of each trench need not exceed 5 feet. Over the angles of intersection, a chimney, some 3 feet high and 3 feet in diameter, must be built of turf-sods or bricks. To support the walls of the chimney where they cross the trenches, iron bands off bales or barrels may be used, or meat-tins with the

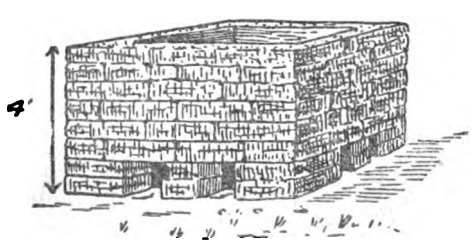

FIG. 15.—CAMP INCINERATOR (RECTANGULAR).

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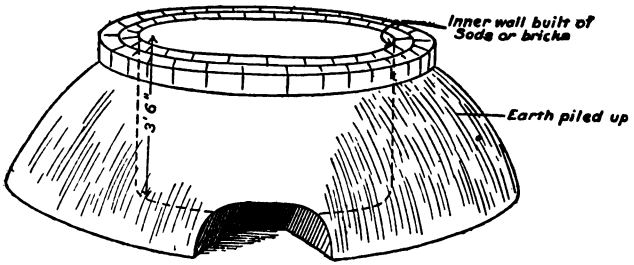

FIG. 16.—CAMP INCINERATOR (BEEHIVE).

bottoms knocked out. A fire can be quickly lighted with any dry material at the bottom of the shaft, and fed steadily by throwing rubbish and refuse down the top.

7. Modifications of this type of incinerator are shown in Figs. 15 and 16; these can be built quite easily of turf-sods or bricks. It is essential to provide sufficient air-inlets at the base and to keep them open. Disused meat-tins, with the tops and bottoms removed, make excellent frames for these openings. The draught is improved by making a heap of stones, about 13 inches high, in the middle of the incinerator.

The best dimensions for the rectangular pattern are 4 feet long, 4 feet wide, and 4 feet high. In the case of the " beehive " type, the diameter should be 5 feet, and the height of wall 3 feet 6 inches.

8. An alternative type of incinerator is a horseshoe-shaped mound of earth, with its mouth to windward. The refuse is burnt within the ramped area, the sides of which need not be more than 3 feet high. This design is particularly suitable when the soil is peaty or friable.

9. Another effective incinerator consists of a circular, shallow, saucer-like depression, 10 feet in diameter, and not more than 2 feet deep in the centre, shelving gradually to the level of the ground at its edge. The whole of this hollow is lined with large stones or broken bricks, and a low wall built up round it, the excavated earth being

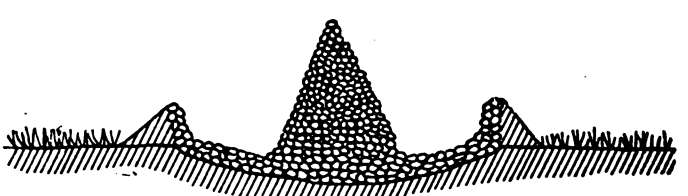

FIG. 17.—CAMP INCINERATOR (STONES).

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packed against it to prevent surface water gaining access, and also to provide a sloping approach for tilting refuse into it. Next, a pyramid of large stones is built up in the centre of the basin; this pyramid should rise so as to have its top some 2 feet or more above the level of the rim or encircling wall (Fig. 17). The object of the central cairn is to provide a steady draught through the centre of the burning material. Ordinary dry wood or brushwood must be used to start the fire, and after it is well burning it can be maintained by steadily adding refuse. The stones soon become intensely hot, and serve to dispose of liquid and damp stuff with rapidity. This incinerator is eminently adapted for stony or rocky country.

10. In places where boulders or large stones or broken bricks are not procurable, a crematory can be made of empty tins of all kinds. The tins are stacked in heaps about 4 feet high, and on and around them is piled the miscellaneous rubbish, which is then set alight. The tins serve to keep an air-space and generate an under-draught, causing the whole heap to burn fiercely. The tins can be used over and over again. Ultimately, all tins and broken hardware should be stacked or, preferably, buried and on no account be left lying about to mark the site of an abandoned camping ground.

11. The making of any of the above designs of incinerator presents little difficulty, and the men of sanitary detachments should be taught their use and practised in their construction. An enormous amount of material can be disposed of in a few hours if the draught trenches or holes are kept clear and the refuse added with ordinary care. Once a fire is well alight in one of these incinerators, even fæcal material from the latrine-buckets can be destroyed by fire, provided it does not cause offence to anyone in the vicinity. Finally, when making these incinerators, care should be taken to cut and stack the turf in the form of sods in order to facilitate its eventual replacement.

12. Where large quantities of manure, litter, and rubbish require burning, an apparatus similar to that shown in Fig. 18 has been found

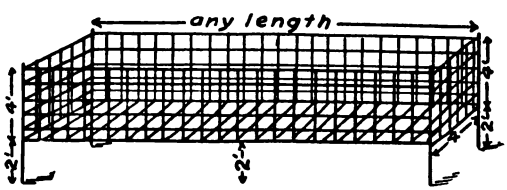

FIG. 18.—CAMP INCINERATOR (WIRE FRAME).

effective. It consists of a large ironwork trough, 4 feet deep and wide, and of any convenient length, raised 2 feet from the ground. The mesh should be about 5 inches square, and can be made from the bands of forage bundles, wire, etc. It must be placed broadside to the wind,

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and the bars forming the bottom made to run from side to side, not lengthwise.

69. *Latrines and Urinals.*

1. In permanent camps the best form of latrine accommodation consists of pail-middens with dry earth, fitted with rough wooden seats, arranged as shown in Fig. 19. This design of fixed latrine

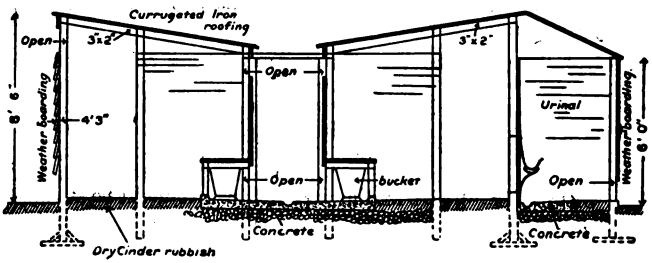

FIG. 19.—DESIGN FOR LATRINES IN A PERMANENT CAMP.

provides urine-troughs for urination draining into tubs or other receptacles or into soakage-pits conveniently placed. This latter arrangement is undesirable unless the ground is very porous and absorbent, but even then the liquid needs frequent covering over with fresh earth. In the majority of cases, for the reception of urine, iron tubs are usually provided, these being placed adjacent to the ordinary latrines for day use, and during the night at selected points convenient for the tents. The contents of the various receptacles should be removed daily, and buried well away from the camp site. The ideal latrine of this form is one in which each pail has a water-tight cover fixed by a bayonet catch. When the receptacles are full the covers are applied, and the covered receptacles are then placed in a cart for removal to the area chosen for disposal. Here the pails are emptied, thoroughly cleansed, and then brushed over with paraffin oil. This procedure is more sanitary than emptying the pails into a supposedly water-tight cart, which has to be again emptied and cleaned on reaching the disposal area. In practice these carts are rarely water-tight, and the contents are often spilled during transit. The carts are also difficult to empty without fouling the ground adjacent to the pit or trench which receives the dejecta. If portable middens, such as pails, are not provided, the seats must be placed over pits or trenches specially dug.

2. Whatever form the latrine takes, its successful management depends absolutely upon rigid adherence to the rule that the excreta must be quickly and completely covered over with earth, and this depends again upon the enforcement of individual sanitary discipline.

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adequate personnel, and competent administrative control and supervision. To secure this, the following conditions should as far as possible be observed :—(*a*) The number of pails provided should be double the number of latrine seats. (*b*) The pails and their contents should be removed in daylight, say between 5 and 7 a.m. (*c*) When the pails in use are removed, clean ones containing a little dry earth should be placed in position. (*d*) A supply of dry earth, sufficiently broken up to pass through a half-inch mesh, should be provided ; also (*e*) boxes or receptacles at each latrine seat to hold earth ; and (*f*) a scoop for each of these receptacles. (*g*) The regular attendance is required at the latrine of a man to remove pails which are full, to replace them with clean ones, and to see that the contents are covered with earth. (*h*) The excreta should be removed daily to a point at least half a mile from the camp.

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NOTE.—The appendices are for reference only and are not to be the subject of examination questions.

APPENDIX I.

TABLE SHOWING ADMISSIONS AND DEATHS, BRITISH TROOPS IN WAR.

Campaign.	Duration in Days.	Average strength during campaign.	All diseases including injuries.		Killed in action and wounds in action.		Ratios per 1,000 per annum. All diseases including injuries.		Killed in action and wounds in action.	
			Admissions.	Deaths.	Admissions.	Deaths.	Admissions.	Deaths.	Admissions.	Deaths.
Crimean War ... 1854–6	773	111,000	...	21,000	...	4,058	...	87·3	...	16·8
Zulu War 1879	273	12,651	9,348	314	162	800	988	33·2	17	84·5
Afghanistan 1878–79–80	710	10,246	28,761	1,122	Included in all diseases	161	1,443	56·2	Included in all diseases	8·1
Egypt 1882	85	13,013	7,212	79	378	93	2,379	26·2	124	30·6
Eastern Soudan ... 1884	52	4,018	314	...	198	126	547	...	347	220·0
Nile Expeditionary Force ... 1884–5	501	10,771	8,712	431	241	126	589	29·1	16	8·5
Suakin Expeditionary Force ... 1885	75	7,235	2,047	17	99	87	1,376	11·2	66	58·3
Soudan 1885–6	57	5,873	1,009	27	43	9	1,100	29·4	47	9·8
Nile Field Force .. 1889	36	1,529	112	2	5	1	742	13·2	33	6·6
Chitral Relief Force 1895	180	5,213	3,935	128	35	13	1,530	49·6	14	5·1
Ashanti Expeditionary Force ... 1895–6	56	884	356	5	...	...	2,624	36·8	...	...
Dongola Expeditionary Force ... 1896	205	1,027	561	47	...	...	976	81·7	...	...
Matabeleland ... 1896	211	665	204	11	4	1	531	28·6	11	2·6
Mashonaland ... 1896–7	192	506	208	1	14	4	782	3·8	53	15·0
North-West Frontier, India ... 1897–8	294	5,741	11,065	291	416	149	2,392	62·9	[illegible]	32·1
Nile Expeditionary Force ... 1898	280	5,024	3,516	127	199	55	1,912	32·9	51	14·2
South African War 1899–1902	961	208,226	404,126	14,024	21,292	6,965	555	25·6	39	12·7
China Field Force... 1900–1	384	1,277	1,343	29	13	8	1,051	22·7	10	2·3

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APPENDIX II.

TABLE SHOWING DEATHS, FOREIGN TROOPS IN WAR.

Campaign.	Duration.	Approximate average strength during campaign.	Killed in action and died of wounds.	Killed in action and died of wounds per thousand per annum.	Died of disease.	Died of disease per thousand per annum.
Crimean war, 1854-6—						
French troops .	26 months	301,000	20,000	30·6	75,000	114·7
United States civil war, 1861-5—						
Federal troops*	49 months	600,000	93,969	38·3	186,216	75·9
Austro - Prussian war, 1866—						
Prussian troops	2 months	437,000	4,450	61·1	6,427	88·2
Franco - Prussian war, 1870-71—						
Prussian troops.	10 months	800,000	28,300	42·4	14,904	22·3
Chino - Japanese war, 1894-5—						
Japanese troops	9½ months	227,000	1,311	7·3	15,850	88·1
Madagascar, 1895						
French troops ..	10 months	18,000	7	·48	5,600	373·3
Spanish-American war, 1898—						
American troops	5 months	270,000	293	2·5	3,681	32·6
Russo - Japanese war, 1904-5—						
Japanese troops	19 months	420,000	58,887	88·5	27,158	40·8
Russian troops .	19 months	490,000	47,608	61·3	27,830	35·8
German S.W. Africa, 1903-6—						
German troops†	31 months	18,000	631	13·5	603	12·9

* 24,184 missing. † 89 missing.

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APPENDIX III.

Scales of Rations on Active Service.

	War Office Scale.* oz.	Indian Scale.† oz.
Fresh meat	20	20 (*a*)
or		
Preserved do.	16	—
or	(nominal)	
Salt do.	16	—
Bread	20	16 (*b*)
or		
Biscuit or flour	16	—
Rice	—	2 (*c*)
Fresh vegetables	8	16 (*d*)
or		
Dried do.	2	—
or		
Preserved fruit	4	—
Sugar	2	$2\frac{1}{2}$
Jam	4	—
Tea	$\frac{5}{8}$	1
Salt	$\frac{1}{2}$	$\frac{1}{2}$
Pepper	$\frac{1}{36}$	$\frac{1}{36}$

* The following may also be issued at the discretion of the G.O.C. on the recommendation of the medical officer :—$\frac{1}{20}$ gal. lime-juice ($\frac{1}{10}$ gill) with $\frac{1}{2}$ oz. sugar, on days when fresh vegetables are not issued; $\frac{1}{64}$ gal. rum ($\frac{1}{2}$ gill); tobacco, not exceeding 2 oz. per week, for those who smoke.

† The following substitutes are also allowed :—

Biscuits	16 oz.	in lieu of bread, 16 oz.
Oatmeal	2 ,,	4 ,, twice weekly.
Condensed milk ...	$1\frac{1}{2}$,,	
Meal (atta)	16 ,,	ration.
Preserved meat ...	12 ,,	fresh meat 16 oz.
Vinegar	$\frac{1}{4}$,,	
Bacon	3 ,,	4 ,, twice weekly.
Cheese	3 ,,	4 ,, ,, ,,
Substitute rations ...	16 ,,	
Dal	4 ,,	vegetables.
Potato chips	3 ,,	preserved vegetables, in lieu of 1 lb. fresh
Pickles	1 ,,	vegetables.
Preserved fruit ...	4 ,,	in lieu of fresh vegetables 8 oz. once a week.
Jam	4 ,,	in lieu of fresh vegetables 8 oz. three times a week.

(*a*) All cuttings, such as heads, tails, hearts, livers, etc., should be collected and stewed down regimentally into soup, and issued free.

(*b*) When marching and for the first seven days of any halt, or for longer if the G.O.C. considers it is necessary, the scale will be increased to 1¼ lb.

(*c*) Three times a week.

(*d*) i.e., potatoes 12 oz., mixed vegetables 4 oz. (onions being supplied as liberally as possible).

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APPENDIX IV.

Space in Barracks Allowed in New Designs.

Stations.	Permanent Buildings.		Wooden Huts.	
	Sq. ft.	Cubic ft.	Sq. ft.	Cubic ft.
Great Britain, Ireland, and Channel Islands.	60	600	60	600
Bermuda, Cape of Good Hope, Cyprus, Egypt, Gibraltar, Hong-Kong (except Victoria), Jamaica (Newcastle and Up Park Camp), Malta, Mauritius (Curepipe and Phœnix), Natal, Sierra Leone (Mount Aureol and Tower Hill).	60	720	60	720
Ceylon, Hong-Kong (Victoria), Jamaica (Port Royal), Mauritius (Port Louis), Sierra Leone (King Tom), Singapore.	80	1,000	75	850
	Plains.		Hills.	
India, British troops...	90	1,440	60	600
India, Indian troops...	60	810	50	600

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